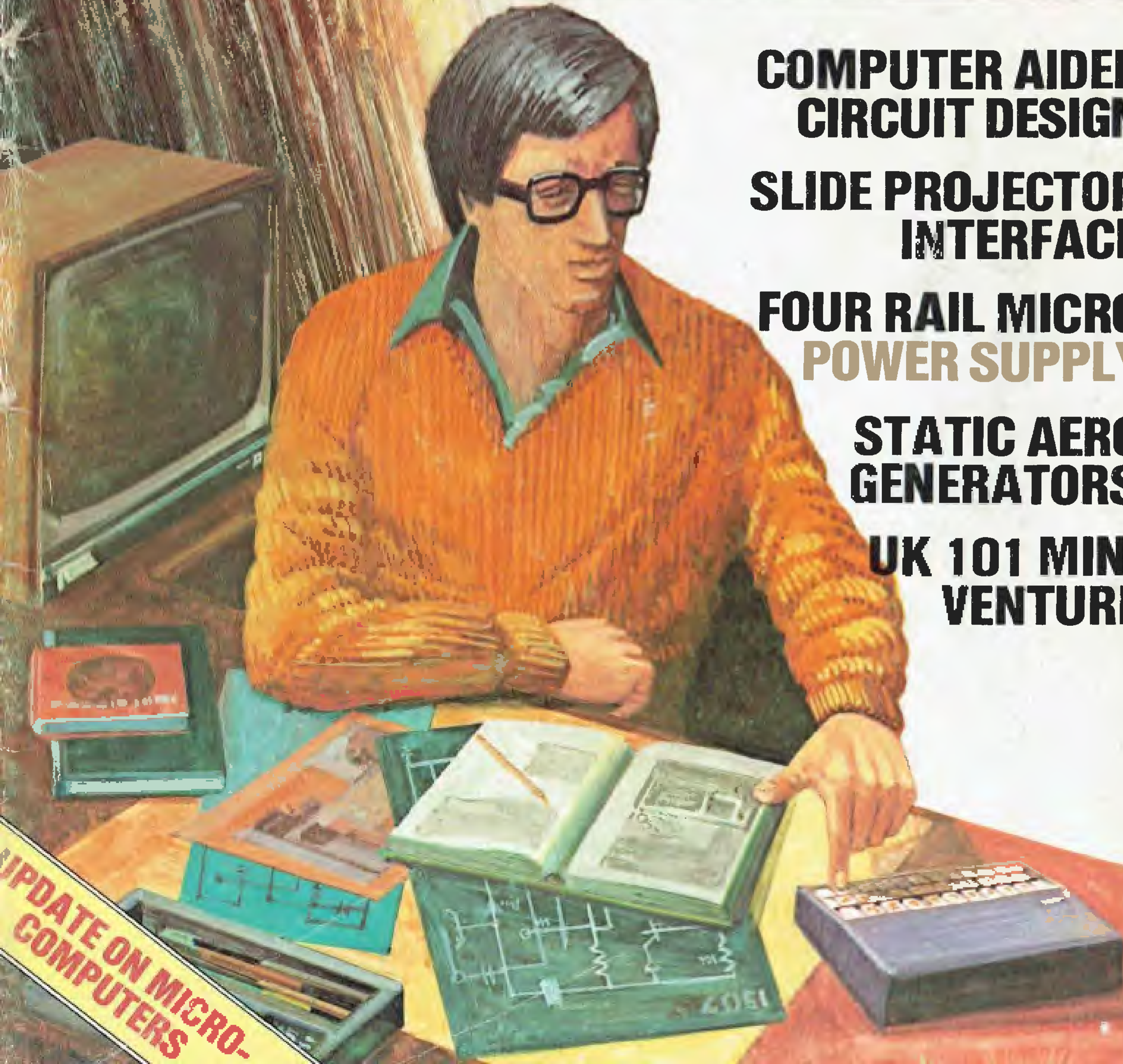
March 1982

0 71639
Canada $1.95
60p

Electronics & Computing MONTHLY

Britain's First Electronics & Computer Applications Magazine



COMPUTER AIDED CIRCUIT DESIGN

SLIDE PROJECTOR INTERFACE

FOUR RAIL MICRO POWER SUPPLY

STATIC AERO GENERATORS

UK 101 MINI VENTURE

UPDATE ON MICRO-COMPUTERS

Commodore VIC–20

A fully-fledged, fully expandible, computer with large typewriter-style keyboard, programmable function keys, PET compatible. Gives 24 colours and sound, (to the degree that it can be used to compose music). High resolution graphics module available as extra. Speaks BASIC. Easy-to-use, even for beginners. New VIC–20 material is available and more is on the way. Supplied with easy-to-read, easy-to-use manual, suitable for beginners and children. Programs can be stored on optional VIC tape recorder. **Commodore approved supplier.**

Texas Instruments TI–99/4
(PAL colour TV compatible)

Usable literally within minutes of unpacking. Anyone can use it without previous computer experience or programming knowledge. Powerful 16K. BASIC language. Special features high resolution graphics let you create animated displays, charts, graphs; built-in music synthesizer allows you to build notes and chords; equation calculator for maths solutions. Designed for home management, educational and entertainment use. Large amount of educational software available on modules for youngsters. Programs can also be stored using good quality tape recorder. **Texas Instruments approved supplier.**

Trust the unique Computer Supermarket to be first with the unique new personal computers.

Four new-technology computers bring you colour, sound, high resolution graphics. All with plug-in program modules. All at unique Computer Supermarket prices.

Atari 400

Brings the family music, art, education, entertainment. A general purpose personal computer that's easy to operate and offers 16 colours, each with 8 intensities; high resolution graphics; 4 sound synthesizers; 57 key alphanumeric keyboard with upper/lower case, inverse video, full screen editing, four-way cursor control, 29 graphics keys. Programming languages: BASIC, ASSEMBLER, PILOT. Programs can be stored on optional Atari tape recorder. **Atari approved supplier.**

Atari 800

Top-of-the-line personal computor. Advanced peripheral components, comprehensive software library. Modular design precludes obsolescence. 16 colours (8 intensities), 4 sound synthesizers; 57 keys with upper/lower case, inverse video, full screen editing, four-way cursor control, 29 graphics keys. Programming languages: BASIC, EXTENDED BASIC, ASSEMBLER, PILOT, PASCAL. Programs can be stored on optional Atari tape recorder. **Atari approved supplier.**

THESE EXCITING NEW PERSONAL COMPUTERS CONNECT TO VIRTUALLY **ANY COLOUR OR MONO TV.** Full range of peripherals will be available for each computer. All units are complete and ready to use. 13 amp plug fitted. Thorn colour TV's can be supplied for use with these computers. Details on application.

Prices include VAT. p&p & insurance £3.50

Your remittance should be made payable to 'Computer Supermarket Ltd', and shall remain your money until the goods have been despatched to you at the address specified. All goods offered are subject to Computer Supermarket conditions of sale, copies available on request. Registered in England No. 2646589.

PRESTEL SERVICE Prestel subscribers can obtain further details on these computers – and place orders for them – through the Prestel service. **PRESTEL No. 400400**

To Computer Supermarket Ltd, Douglas House, Queens Square, Corby, Northants.

Please send me

- ☐ Commodore VIC–20 at £192.50
- ☐ Texas Instruments TI–99/4 at £302.50
- ☐ Atari 400 at £348.50
- ☐ Atari 800 at £648.50
- ☐ Hardware/Software list
- ☐ Atari tape recorder at £45 inc. VAT, p&p
- ☐ VIC tape recorder at £40 inc. VAT, p&p

I enclose my cheque for £ ________

Or debit my Access/Barclaycard/Diners Card No. ________

Signature ________

Name ________

Address ________

________ (BLOCK CAPITALS PLEASE) EC

COMPUTER SUPERMARKET

COMPUTER SUPERMARKET LTD, DOUGLAS HOUSE, QUEENS SQUARE, CORBY, NORTHANTS. TELEPHONE 05366 61587/8 AND 62571

Step by step with the computer system designed for tomorrow.

Microtan 65

£79·00 +VAT Ready Built

£69·00 +VAT Kit

* 6502 Microprocessor
* 2K Monitor TANBUG
* Intelligent socket accepts keypad or full ASCII Keyboard
* Chunky Graphics and Lower Case Options
* Connects to unmodified B/W or Colour TV

For the first time buyer or experienced user, Microtan 65 is a superb route into personal computing. If you are looking for a sophisticated machine with the capability of expansion into a professional system, then this is the

computer for you. Step by step with the computer system designed for tomorrow. . . .

6502 Microprocessor

Probably the most popular CPU (central processing unit) for personal computers, having a powerful instruction set and architecture.

2K Monitor TANBUG

The built-in 'mind' of the machine, TANBUG controls all system functions and gives comprehensive machine-code facilities. Functions include:- set and clear breakpoints, single step through program, execute program, copy block of memory, modify memory locations and much more.

Intelligent keyboard socket

For absolute beginners we can supply an easy to use 20-way Hex keypad; for the more experienced user there is a full typewriter style ASCII keyboard. Either way, Microtan will work out exactly which type you are using and act appropriately.

Chunky Graphics Options

For drawing simple lines and graphs,, or for animated games, Chunky Graphics is a low cost answer. This set of chips plug into the Microtan board and allow graphics to be built up on the screen at a resolution of 64 rows by 64 columns.

Lower Case Option

To extend the character set to 128 characters, allows for real descenders on lower case characters and a set of extra symbols and characters for simple graphics.

Microtan Accessories

20-way Hex keypad MPS 1 Basic power supply

Aerial connector lead

Full ASCII Keyboard
MPS 2 Full system power supply
Mini — motherboard

Microtan is available ready-built or as a kit. We recommend that you should have some soldering experience before attempting the Microtan Kit, although if you do run into problems you can make use of our "Get you Going" service (telephone for details).

TANEX

* 7K Static Ram
* 10K Microsoft Basic
* 32 Parallel I/O lines
* 1 Serial I/O port
* XBUG
* Cassette Interface

The first step in expanding your system. Tanex provides the extra facilities necessary for the serious programmer. Memory expansion: Tanex has provisions for up to 7K of static RAM and up to 14K of EPROM using 2716 or 2732 chips.

XBUG and BASIC

XBUG is a 2K extension to TANBUG that contains a mnemonic assembler and disassembler and cassette firmware running at 300 Baud CUTS, standard or high speed 2400 Baud Tangerine standard with 6 character filenames. Tangerine have taken out a full O.E.M. licence for Microsoft BASIC, the microcomputer industry standard, this is a full feature implementation with interrupt and machine code handling, and a superb program editor. Both XBUG and BASIC plug directly into Tanex and are supplied with comprehensive user manuals.

Parallel I/O

When fully expanded Tanex includes two V.I.A.s (Versatile Interface Adaptors) which implement the cassette interface and the parallel I/O ports. Software in TANBUG V2.3 enables you to plug in and use a Centronics type printer. The two V.I.A.s also contain counter timers that can be used for a variety of applications enhanced by the use of the integral handshake facilities.

Serial I/O

Also on the expanded board is a serial I/O port that can be used to interface RS232 or 20Ma loop terminals or VDU's, again all controlled by TANBUG V2.3.

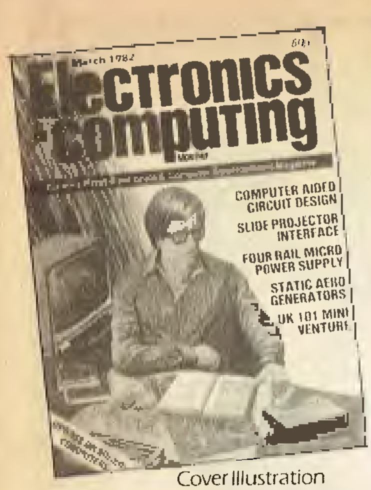
tangerine
computer systems ltd
Forehill Works, Ely,
Cambs. CB7 4AE.

TO TANGERINE COMPUTER SYSTEMS LTD.,
FOREHILL WORKS, ELY, CAMBS. CB7 4AE.

PLEASE SEND ME:

- ☐ MICROTAN 65, READY BUILT £92.35 incl. VAT+P&P.
- ☐ MICROTAN 65 KIT £80.85 incl. VAT+ and P&P.
- ☐ TANEX (MIN CONFIG) KIT £50.95 incl. VAT and P&P.
- ☐ TANEX (MIN CONFIG) ASSEMBLED £62.45 incl. VAT and P&P.
- ☐ EXPANDED TANEX KIT £104.66 incl. VAT and P&P.
- ☐ EXPANDED TANEX ASSEMBLED £116.16 incl. VAT and P&P.
- ☐ PLEASE SEND ME THE NEXT SIX ISSUES OF TANSOFT GAZETTE AT £15.00.

I enclose my cheque for £ ....
or debit by Access/Barclaycard
....
Signature ....
Name ....
Address ....
....
.... (Block capitals please) ECM 3



Cover Illustration by Glenn Price

Editorial/Circulation Control
67 High Street,
Daventry, Northampton.
NN11 4BQ
Tel: 03272 71841

Publisher/Editorial Director
David Raven

Production Editor
Glenn Price

Editorial, Consultant
Trevor George

Group Sales Director
R.E. Pynegar

Advertising
(03272) 71702

Circulation & Office Manager
Diana Ward

Subscription Control
Suzanne Gilbert

Distribution
Seymour Press Ltd
334 Brixton Road
London

Published by
Stagpark Limited
Russell Anderson House
18 Hamilton Road
Nottingham

Production
Newstead Publishing Ltd
Nottingham

Printed by
LSG Lincoln

In this months issue

SLIDE PROJECTOR INTERFACE

An inexpensive way of storing static praphic images to supplement lectures, computer aided learning, training, advertising or sales promotions with out the need of a human operator. **18**

GENIE PROJECT

This is a useful circuit which demonstrates an application for putting a taped instruction into an EPROM. **23**

MEMORY

Some of the traumatic experiences Ian Sinclair encountered having decided to take the risk to expand a TRS 80 to 48K. **25**

COMPUTER AIDED DESIGN

The first in our series of CAD programmes on a ZX81 with 16K and printer. Given a design of circuit and values it is simple to evaluate THE EXACT PERFORMANCE, BUT IT IS VIRTUALLY IMPOSSIBLE to start from a desired characteristic & calculate the exact values of components to produce it-but a computer does help. **27**

MICRO-COMPUTER UPDATE

An in depth look at the small computer market. **30**

IN SEARCH OF GOLD

Designed to run on a UK 101 with monitor & 7K of Ram you'll be meeting strange things inhabiting the caves to stop you getting the treasure. **36**

THE HOME COMPUTER AS A TEACHING AID

One of the beauties of this programme is that the child does not need to be able to name the particular letter appearing on the screen, it's a simple case of shape recognition. **38**

FOUR RAIL POWERSUPPLY

A reasonably heavy duty unit that is fairly compact and should fit into the larger types of cases which can double up as a general purpose power supply. **42**

AERO GENERATORS

Generating electricity mechanically from the wind is well known. Gyroscopic strain forces can be a problem involving high rectification costs which compare unfavourably with static generators. **46**

KIT REVIEW

A step by step guide to building a logic probe making a useful piece of test equipment for digital repair work or commissioning new circuits. **48**

TALKING SHOP

News & Views that you are not always meant to hear from inside the electronics industry. **58**

SOFTWARE

Part six of Mike James's feature on Building Basic to help you write your own programmes. **61**

NEWS

7 International News
11 Electronic Components News
13 Computer Product News
41 Special Offer
65 Book Shop
67 Book Review

Electronics & Computing Monthly is normally published on the second Friday of each month.

Sinclair ZX81 Personal Comp[uter]
the heart of a system that grows with you.

1980 saw a genuine breakthrough – the Sinclair ZX80, world's first complete personal computer for under £100. Not surprisingly, over 50,000 were sold.

In March 1981, the Sinclair lead increased dramatically. For just £69.95 the Sinclair ZX81 offers even more advanced facilities at an even lower price. Initially, even we were surprised by the demand – over 50,000 in the first 3 months!

Today, the Sinclair ZX81 is the heart of a computer system. You can add 16-times more memory with the ZX RAM pack. The ZX Printer offers an unbeatable combination of performance and price. And the ZX Software library is growing every day.

Lower price: higher capability
With the ZX81, it's still very simple to teach yourself computing, but the ZX81 packs even greater working capability than the ZX80.

It uses the same micro-processor, but incorporates a new, more powerful 8K BASIC ROM – the 'trained intelligence' of the computer. This chip works in decimals, handles logs and trig, allows you to plot graphs, and builds up animated displays.

And the ZX81 incorporates other operation refinements – the facility to load and save named programs on cassette, for example, *and* to drive the new ZX Printer.

Every ZX81 comes with a comprehensive, specially-written manual – a complete course in BASIC programming, from first principles to complex programs.

Kit: £49.95

Higher specification, lower price – how's it done?
Quite simply, by design. The ZX80 reduced the chips in a working computer from 40 or so, to 21. The ZX81 reduces the 21 to 4!

The secret lies in a totally new master chip. Designed by Sinclair and custom-built in Britain, this unique chip replaces 18 chips from the ZX80!

New, improved specification

- Z80A micro-processor – new faster version of the famous Z80 chip, widely recognised as the best ever made.
- Unique 'one-touch' key word entry: the ZX81 eliminates a great deal of tiresome typing. Key words (RUN, LIST, PRINT, etc.) have their own single-key entry.
- Unique syntax-check and report codes identify programming errors immediately.
- Full range of mathematical and scientific functions accurate to eight decimal places.
- Graph-drawing and animated-display facilities.
- Multi-dimensional string and numerical arrays.
- Up to 26 FOR/NEXT loops.
- Randomise function – useful for games as well as serious applications.
- Cassette LOAD and SAVE with named programs.
- 1K-byte RAM expandable to 16K bytes with Sinclair RAM pack.
- Able to drive the new Sinclair printer.
- Advanced 4-chip design: microprocessor, ROM, RAM, plus master chip – unique, custom-built chip replacing 18 ZX80 chips.

Built: £69.95

Kit or built – it's up to you!
You'll be surprised how easy the ZX81 kit is to build: just four chips to assemble (plus, of course the other discrete components) – a few hours' work with a fine-tipped soldering iron. And you may already have a suitable mains adaptor – 600 mA at 9 V DC nominal unregulated (supplied with built version).

Kit and built versions come complete with all leads to connect to your TV (colour or black and white) and cassette recorder.

COMMENT

Chapter Three — 16-bit and applications

Historians of electronics and computing will not need reminding of past technological events however, many of the younger readers may enjoy a short recap.

Chapter 1 concerned the major advances in silicon technology which occured in the late fifties and early sixties. This event culminated in the USA landing two men onto the surface of the Moon — 20th July, 1969. It also marked a new stage in the evolution of semi-conductor technology, the arrival of 'large scale integration' (LSI) and Chapter 2. From this same process evolved the microprocessor and supporting devices for the micrcomputer. In 1975/76 each month revealed a new process or piece of high technology:-

Nov-75 - First use of 16K RAM chips in a commercial computer system.

Feb-76 - First samples of 16K RAMs enter the market.

Mar-76 - First commercial ROM to hit 32K level is marketed.

May-76 - First of the enhanced 8-bit general purpose microprocessors appear.

Sep-76 - First commercial bubble memory production starts with a 92K device.

With the aid of the excellent chronology published annually in 'Electronics International' I could continue recording firsts upto this present time. Chapter 2 then was all about developing devices to build-up the complete microcomputer system, now we come to Chapter 3.

While device technology continues to forge ahead and plays a leading role in the expansion of the hardware systems a limiting factor is the development of software. We will see more emphasis being given to the software development of existing systems and increased applications packages.

Machines that can run on wide range of software will be in demand making them less dependant on a particular programming language.

In order to provide the large memory which these machines require, manufacturers are turning to 16-bit microprocessors (see Jan 82 issue of 'Electronics & Computing Monthly'). Although the first 16-bit devices were launched back in 1978, they are only just beginning to make an appearance in microcomputers. The ACT SIRIUS 1, launched at the 'Which Computer Show' in January, and featured in our new products section this month, is highly rated and threatens to stir up trouble for both PET and APPLE. Tandy have also announced a 16-bit machine by the end of 1982 and it is very likely there are others under wraps.

All of these developments are of course, quite typical of the electronics industry and it certainly doesn't pay to hang around waiting for whats coming next. If you've made a decision to buy a micro' then don't be put off, otherwise you will never get started. One other cautionary note to bear in mind is it often takes quite a while to get things right with a new high technology product and although the specification looks very attractive, delivery and support may not always be as well established.

On the subject of development and the problems companies run into with the design of custom made logic chips, it was disappointing news to hear that the BBC machine would not be available in time for the start of the series. The program went on the air on January 14th screened specifically at Schools. Only 300 of the promised 500 BBC Micro's were in position, and there still doesn't seem any likelyhood of the general public obtaining them before the end of March.

We ourselves have ordered one through a private individual, in order to get a standard production model, so that may explain our lack of reviews etc, on this very promising machine.

I personally can think of very few occasions when developments using custom designed chips are ready on time and it would surely be more sensible for manufacturers to take this into account, with launch dates. The problems that I see having resulted for both Acorn and the BBC is that they have now soured the massive public enthusiasm for their product which resulted in thousands of orders being placed with virtually no advertisement cost involved. In addition it hasn't done much good to the sales of the Acorn Atom which despite the announcemet of the BBC machine, is highly rated and regarded as a reliable home computer. Perhaps with hindsight it would have been better to have kept the BBC Micro under wraps for a bit longer and produced a less ambitious model based around an existing Micro with a proven track record. Still I suppose we can all be wise after the event.

The result of our request in previous issues for articles, projects and software, has been very encouraging and we would like you to continue sending them in. I am afraid we have slowed down in our response to reader's correspondence, almost in direct proportion to the increase in our magazine sales. To this end we are installing — yes you've guessed it — a microcomputer. With the aid of this new wonder machine which will cost — an arm and a leg — I can hopefully speed up my personal response to readers. If it all works correctly you won't even know if it's me writing to you or the impersonal word processor. I am quite certain however, that there will still be plenty of readers and contributors who still receive one of my hastily hand-written notes. It would surprise readers to learn how un-computerised edioríal offices of computing magazines are.

One final note, our apologies to a certain gentleman living in Bolton whose telephone number appeared in an advertisement last month for Knights TV of Aberdeen. The incorrect dialing code published resulted in Mr X from Bolton, receiving dozens of telephone calls intended for Knight's.

Publisher

Dr. John Nunn (right) and the Chess Champion Mark V computer ponder over the Russian problem, watched by International Master David Levy.

Chess Experts Embarrassed by Computer

Hot on the heels of our Computer Chess feature (January issue) which predicted the growing challenge of computers against the grand masters. We now have a report of a chess computer outsmarting several leading Russian chess experts. Soviet chess problem expert, L. Zagorujko, won first prize in an important competition in 1972. By composing a particular chess problem for which a distinguished panel of judges was not able to find a solution — apart from the one proposed by Zagorujko himself. A chess problem must have only one possible solution in order to win such a competition. After nearly ten years have passed since the competition and the problem has appeared in many newspapers and magazines around the world (without any solutions having been published) a chess computer the Chess Champion Mark V has come up with not just one but three correct solutions. International chess experts were said to be astounded by the machines discovery during a "man-versus-machine" chess problem-solving contest at the end of a chess tournament held in Brighton. The Mark V, manufactured by Scisys Computers Ltd., was competing against International Master Dr. John Nunn. The Zagorujko problem was one of six 'brain-teasers' shown to Nunn and the Mark V by Mr Barry Barnes, Vice President of the Problem Commission of the World Chess Federation. Nunn eventually gave up on the Russian's problem, saying he felt there was probably more than one solution but he could not find it. The Mark V however continued and produced Zagorujko's solution plus two others.

British Firm Launch Heart Rate Meter

A British company based in New Barnet has developed a new battery powered heart — rate meter for use by Athletes. A photo electric sensor clips on a finger with the instrument strapped to the wrist during exercise. The first reading is made about 10 seconds after the meter is attached and it is calibrated to indicate on a scale from 30 to 200 pulses per minute.

The instrument is said to be very useful in determining the maximum natural heart-rate of athletes under sustained maximum effort and also the recovery of heart-beat to normal level after extertion.

Further information can be obtained by telephoning George Dudley Sports, 01-440 0910.

Milton Keynes User Group First Seminar

In an effort to spread the gospel of computers and information technology, Milton Keynes User Group have held a Saturday Seminar/Workshop. Over 75 people attended and seminars were held on "Micros in Education", ZX81 Guide, Atom Review and Speech Synthesis. In addition there was a Sharp Computer review, Micros in Busines, TRS80. Several trade stands were also in attendance.

Due to the good response to the pilot workshop, plans have now been made to hold quarterly Saturday Seminars. Milton Keynes User Group meets weekly on a Tuesday evening at Woughton Centre, Milton Keynes. Their meetings include short sessions on such subjects as assemblers, basic operating systems etc; which are optional, while the rest of the group develop software games in addition to more serious programs. Anyone is welcome with or without a machine and for more details contact John Chewter Milton Keynes 676996.

Telephone Terminal Development between ICL and Sinclair

A new sophisticated telephone terminal is to be jointly developed by a joint venture link up between Sinclair and ICL. Incorporated in with the system would be Sinclair's own flat-screen TV display which is currently still under development. ICL also announced in a report published in the Financial Times that they planned to manufacture a personal computer designed by RAIR, a British company. This particular computer is designed for the small business market.

The desk-top terminal to be developed with Sinclair would have a built in screen about 12 inches across and 1 inch deep. It would be used to display information transmitted from one computer terminal to another also for voice communication. The terminal naturally lends itself to be incorporated in to an electric mail system. Plans by Sinclair to start production of the flat-screen TV are due to start in about six months time at a factory in Scotland. Initial output is expected to be 1m screens annually rising to 3m by the end of next year.

Computer Open Days to be Held in key Cities

Exhibition specialist Couchmead Communications Ltd; is to hold a one-day computer exhibition almost every fortnight throughout 1982. The exhibitions, called Computer Open Days, will be held in key cities throughout the country. John Godley, managing director of Couchmead explained that each Computer Open Day will have about fifteen exhibitors who will collectively show a broad range of computers and peripheral services. Each show will open from 10.00 a.m. to 5.00 p.m. and admission will be by ticket obtainable free from the exhibitors and the organisers.

Godley confidently expects an average attendance of around 400 at each show "We have already held three Computer Open Days this year, and these have attracted an average of 200 visitors with little advance publicity," he said. The computer industry's response to the Computer Open Day idea has been very encouraging," Godley added. "The Open Day concept offers companies an inexpensive way of exhibiting their products and services regionally, and a number of firms have already booked for the whole series.

The Computer Open Day Programme for the first four months of 1982.

JANUARY
13th: SOUTHAMPTON, Polygon Hotel, Cumberland Place.
27th: CHELTENHAM, Queen's Hotel, The Promenade.
FEBRUARY
10th: HARROGATE, Majestic Hotel, Ripon Road.
24th: SWANSEA, Dragon Hotel, The Kingsway.
MARCH
10th: NOTTINGHAM, Albany Hotel, St. James's Street.
24th: IPSWICH, Great White Horse Hotel, Tavern Street.
APRIL
14th: WESTON-SUPER-MARE, Grand Atlantic Hotel, Beach Road.
28th: MANCHESTER, Grand Hotel, Aytoun Street.

Other venues planned include: Rugby, Taunton, Newport, Glasgow, Sheffield, Liverpool, Edinburgh, Birmingham and Newcastle-upon-Tyne.

Further information on the Computer Open Day series of exhibitions may be obtained from Couchmead Communications Ltd., St. Bernards House, Stoney Lane, London, SE19 3BU, tel: 01-653-1101, up to 23.12.1981, and at their new address: Couchmead House, 153 High St., London, SE20 7DS, tel: 01-778-1102, from 23.12.1981.

Videodisc Concept Slow to Get Going

Video Disc Players which have been hailed as the next generation of video recording systems which could possibly replace tape are not catching on as quickly as manufacturers would have liked.

The first of these machines to successfully hit the market was from the entertainment group RCA. After a major investment program of £100m to develop a video disc system RCA have announced cut backs in their production targets. RCA have sold 60,000 units since their machine was launched which is substantially below their target figure of 200,000 forcast when the video disc player went on sale eight months ago.

The company say they have actually produced in excess of 135,000 units however many of these are still held in stock by suppliers and are said to subject to heavy discounting. New disc titles are being launched all the time by RCA and it is hoped that by the year end their will be more than 300 to choose from.

Video Genie Prize Winner

The lucky winner of our Video Genie competition was picked out from many thousands of entries by Mr Robert Stead of Lowe Electronics.

The splendid prize was won by Mr B. C. Towers, of 63, Brook Hall Road, Ipswich. Congratulations.

MIRO-CHIP THEFTS CAUSE CONCERN

Thefts of a new kind are worrying manufacturers and the authorities in the USA. This new type of crime has recently involved the removal of £1.4m worth of semi-conducter devices from Monolithic Memories Incorporated a Californian based component manufacture (Financial Times) Thefts from the major manufacturers in Silicon Valley are not now uncommon and it is reported that they are losing on average £10.2m worth of goods a year. This most recent theft at Monolithic is reported to be unusually large. Thieves took more than 450,000 circuits and only required a small van to cart them away.

The devices stolen were all ready for shipment and had been completely tested to military standards. The concern of the company and undoubtably the American authorities is that there could be some International involvement and that the devices could end up behind the Iron Curtain. The problems facing manufacturers is severe since extremely valuable devices can simply be carried away in a persons pocket.

continued from page 54

```
 930 PRINT "SELECT OPTION REQUIR
ED"
 940 PRINT TAB 8,"1  [illegible]
[illegible]
 950 PRINT TAB 8,"2  [illegible]
[illegible]
 960 INPUT A(1)
 970 IF A(1)=1 THEN GOTO 700
 980 IF A(1)=2 THEN GOTO 35
1000 CLS
1010 REM "BAL SHEET"
1015 LET A(18)=A(14)+A(18)
1020 LET A(20)=A(16)+A(15)-A(18)
1025 LET A(19)=A(12)-A(14)
1040 LET A(17)=A(16)+A(15)
1045 LET A(14)=0
1060 LET B(4)=B(4)+1
1064 IF B(4)=13 THEN LET B(3)=B(
3)+1
1065 IF B(4)=13 THEN LET A(16)=A
(22)
1066 IF B(4)=13 THEN LET B(2)=B(
2)+1
1067 IF B(4)=13 THEN LET A(18)=0
1068 IF B(4)=13 THEN LET A(17)=0
1069 IF B(4)=13 THEN LET A(19)=0
1071 IF B(4)=13 THEN LET A(15)=0
1072 IF B(4)=13 THEN LET A(20)=0
1075 CLS
1079 IF B(4)=13 THEN LET B(4)=0
1080 PRINT TAB 8;" BAL [illegible]";B(
2)
1085 PRINT "MONTH NUMBER ",B(4)
1090 PRINT "TOTAL B/F FROM";B(3)
;"=";A(16)
1095 PRINT "TOTAL PAY=";A(15)
1100 PRINT "TOTAL=";A(17)
1110 PRINT "TOTAL EXP=";A(18)
1120 PRINT "MONTHLY BAL=";A(19)
1130 PRINT "CURRENT BAL=";A(20)
1140 PRINT TAB 8;" [illegible]"
1150 PRINT TAB 8;" LLOYDS [illegible]"
;A(10)
1160 PRINT TAB 8;" [illegible]"
;A(2)
1170 PRINT TAB 8;" SUN [illegible]"
;A(21)
1171 LET A(22)=A(10)+A(21)+A(2)
1175 PRINT TAB 8;" TOTAL [illegible]"
;A(22)
1210 PRINT "SELECT OPTION REQUIR
ED"
1220 PRINT TAB 8,"1  [illegible]
[illegible]
1230 PRINT TAB 8,"2  [illegible]
[illegible]
1240 INPUT A(1)
1250 IF A(1)=1 THEN GOTO 1075
1260 IF A(1)=2 THEN GOTO 35
1270 CLS
1280 PRINT TAB 8,"SAVE ON TAPE [illegible]"
1290 PRINT
1300 PRINT TAB 5,"PREPARE TAPE [illegible]
[illegible]
1310 PRINT
1320 PRINT TAB 5,"WHEN READY [illegible]
[illegible]"
1330 PRINT TAB 5,"AND NEWLINE [illegible]"
1340 STOP
1345 SAVE "HOME BUSINESS"
1350 GOTO 35
```

THE DREADED GOLF PROGRAM

In the December issue of E&CM we published a "'Golf Program" which caused a few tears. An amended version was again published in the January issue however, several readers still found problems with it. We suspect the ZX81 keyboard may be the cause of some of the errors. (we have a full size keyboard) also the fact that it is a very long listing may have produced further errors.

For readers who only purchased the January issue we have printed below additional notes which should provide all the answers.

This program does work — honest — we have seen it in action also, it has been laoriously keyed in again from the magazine.

1

REM

Graphic T

Inverse K

Y

Graphic A

NOT (Function N) – Four times

((Left bracket – Shift I)

IF (Use Shift 3 to get "THEN", press U to get "IF" then RUBOUT "THEN")

TAN (Function E)

2. The graphic character used in Line 1070 is a graphic H twice.

The graphic character at Line 1160 is a graphic B (inverse*). This is also used at lines 1255 and 1730.

Line 1340 is six "inverse spaces"

Line 1705 is "inverse H"

Line 1710 is "graphic H"

Line 1715 is "graphic A"

Line 1720 is "inverse space"

Line 1725 is "full stop"

Line 1730 is "inverse*"

Line 1735 is "space"

Line 1005 says GOTO 1105 which does not exist. This does not matter as BASIC will automatically continue to Line 1110.

136 New Words from Celdis for DIGITALKER Speech Synthesis System

A new Read Only Memory (ROM) chip set is now available from Celdis which adds a further 136 new words to the standard vocabulary for National Semiconductor's DIGITALKER speech synthesis system. Known as the DT1057, the chip set comprises two 64K ROMs which contain the new 136 words as well as the 138 words previously available.

Essentially, DIGITALKER comprises a speech processor chip and the speech ROMs which, when combined with an external filter amplifier and speaker, forms a system that will generate high-quality speech, including natural inflections (such as local accents). The SPC is capable of directly accessing up to 128K-bits of memory (I.E. the two 64K-bit ROMs which form the DT1057), however, for applications requiring additional vocabulary, the memory addressing capability can be expanded with a minimal amount of external logic.

Other DIGITALKER chip sets available from Celdis include the DT1000 Evaluation Kit with a 138 word vocabulary, the DT1051 Evaluation Kit with an 18 word vocabulary and the DT1052 Kit with Basic numbers. These kits allow designers and engineers to evaluate the DIGITALKER chip sets prior to designing them into an end product.

The DT1000 Evaluation Board contains all the necessary components required to output high-quality speech, including an SPC controller, two speech ROMs, linear filter, 0.5W audio amplifier, keyboard and COPS/ processor, complete with the necessary explanatory data. The only external hardware required to operate the kit is a single 7-11V d.c. power supply and a speaker chosen for the size and quality required.

The two speech ROMs provided with the DT1000 contain the original 138 word vocabulary consisting of numbers, letters of the alphabet, a selection of useful nouns, verbs and tones and five different individual silence durations of 20mSec, to 320mSec in length. The silence durations are provided to allow phrases to be constructed with variable pauses between words. This can also be of help when joining two words together to form one, such as 'milli ampere', where a period of silence between the two words adds to the overall authenticity.

The kit can be operated in six different operating modes, each controlled by programs resident in the COPS processor. Each mode is selected by entering a pre-defined key sequence on the keyboard. These modes include automatically outputing each word in the library sequentially, repeating a selected word, building up and storing short phrases for later output, outputing a 'canned' phrase in which selected words can be changed, a simple game and outputing the hexadecimal equivalent of a decimal number input.

All DIGITALKER chip sets can be easily interfaced to most popular microprocessors for integration into a complete system. Typical applications will include teaching aids, clocks, telecommunications, computer games and a wide range of consumer products.

For further information:
Celdis
37 Loverock Road
Reading
Berks
RG3 1ED
Telephone: (0734) 586191

New Software Conversion Tools

Rapid Recall are now able to offer two new software conversion tools that will allow programs written for the Z80 and 6800 family of processors to be converted for use with the Intel 8086/8088 processors. Known as Zcon (for the Z80) and Mcon (for the 6800), the converters have been developed by Intel. Designed to run under Intel's powerful ISIS II operating system, both Zcon and Mcon assume that the source program is in Intel file format on floppy disc, and that either source is capable of being assembled without errors.

Interest for the new converters is expected to come from established Z80 or 6800 users who wish to use the 16-bit architecture of the 8086/88, without spending time and effort on software conversion.

For further information:
Rapid Recall Limited
Rapid House
Denmark Street
High Wycombe, Bucks.
Telephone: (0494) 26271
Telex: 837931

New Low-Power Version of Z80

Zilog have just introduced a new version of their Z80 8-bit microprocessor which consumes only 10% of the power of the standard Z80. Known as the Z80L, the new processor is available for operation at clock rates of 1 MHz, 1.5 MHz, or 2.5 MHz as identified by the suffix L1, L2 or L3 respectively.

Power consumption for the Z80L family is 75mW, compared with 500 to 750mW for the standard part, and is therefore suited for use in hand-held or portable battery powered products. By the same token, the low power consumption allows battery backup to be implemented easily in systems or where the application relies on continuous processing.

Another important feature of the Z80L is its full pin and software compatibility with the Z80 allowing it to be used in existing circuit boards without the need for expensive circuit re-design. In addition, the new device is fully supported by Z80 development systems and in-circuit emulators allowing products based on the Z80L to be developed, tested and debugged quickly, thus reaching the market place in the shortest possible time.

The Z80L can be used with the complete range of Z80 8-bit peripheral devices currently offered by Zilog. In the near future a new range of low-power peripherals will be announced including versions of the PIO (Parallel input/output), SIO (serial input/output), CTC (counter/timer circuit) and DART (dual asynchronous receiver/transmitter). These devices will consume about 10% of the power of currently available products at prices substantially lower than CMOS equivalents.

The Z80L family employ a single +5V power supply and operate over the temperature range 0 to 70°C. They are available in either ceramic or plastic packages.

For further information:
Zilog (UK) Limited
Babbage House
King Street
Maidenhead
Berks SL6 1DU
Telephone: (0628) 36131
Telex: 848609

Lightweight Computing

A compact stand-alone microcomputer that occupies about the same desk area as a piece of foolscap paper has been introduced by Equinox Computers under the brand name "Episode".

"Episode" is a new lightweight computer powered by the Z80A microprocessor.

It is claimed that the machine will operate with virtually any VDU and printer, and can be used as one of the stations in a network linked to other equipment such as the Government approved Equinox 200.

Mobility is a prime asset. It weighs only 15lb, making it easy to transport and nudge aside to make desk space for other work.

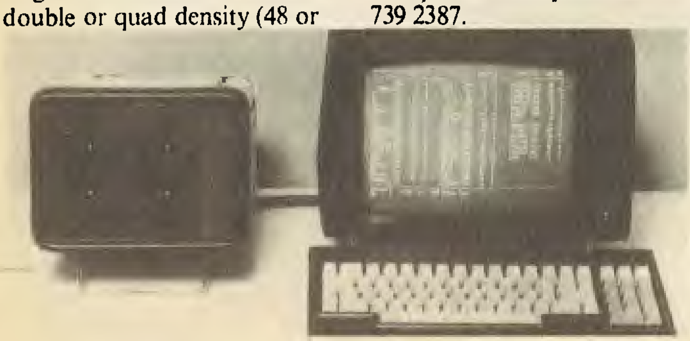
Though physically small (7.5 inches high x 9.5 inches wide x 14.5 inches deep), the Episode has a large integral storage capacity. This is provided by two, 5.25 inch floppy disk drives which can be either single or double sided and double or quad density (48 or 96 TPI), thus giving from 400KB to 1.6MB of unformatted storage.

Other features are two RS232C serial interfaces and a Centronics compatible parallel interface; a battery operated calendar clock, and 64K of dynamic RAM.

In addition to standard CP/M compatible word processing and information management software systems, Equinox will be offering Episode with a suite of market proven commercial packages, including Invoicing, Stock Control, Sales, Purchase and Nominal Ledgers and Sales Management. For the software writer, there will be a wide range of high level languages and utilities, including BASIC, Fortran, Cobol, Pascal, APL, etc.

Episode is available only from Equinox and its approved distributors and may be purchased with the user's choice of VDU and printer or as a stand-alone unit. The latter configuration with 1.6MB of storage is competitively priced at £1995 plus VAT.

Enquiries to: Mike Kusmirak at Equinox Computers on 01-739 2387.



The compact Episode microcomputer (left) from Equinox Computers takes up approximately the same desk space as a piece of foolscap paper.

New Low Cost Raster Graphics System

A high resolution, interactive, monochrome raster graphics system is now available from R & H Systems Limited of Wellingborough. The system, called G-1000, is designed for applications such as CAD/CAM, plot previewing, electrical engineering, scientific data analysis, mapping and circuit board design which require precise detail and data manipulation capability plus economy.

The Genisco G-1000 is the first low cost raster graphic display system to be based on the Z8001 segmented 16-bit microprocessor. This makes it plug-compatible with the Tektronix 4014-1 terminal and it is user programmable, offering up to 16K words of EPROM as well as 16K RAM.

The G-1000 is ideal for both OEM and end user applications. It can be up and running immediately with existing software.

The new Genisco terminal also offers the user the advantages of raster scan technology, as opposed to storage tube, which includes selective erase of any portion of the graphic or alphanumeric image. High contrast and brightness using a black and white screen permits clear viewing in normal light.

Resolution of the G-1000 is 1024 x 792 x 1 bit. It has a detachable keyboard with typewriter-style alpha-numeric keys, special function keys, a 12-key numeric pad and cursor controls for interactive capability.

In addition it incorporates an asynchronous serial interface which is RS232 compatible with data rates to 19.2K baud.

Product enquiries to be sent to: Peter Wright, R & H Systems Ltd, Oxford House, Oxford Street, Wellingborough, Northamptonshire NN8 4HG. Tel: 0933 227477.

The 128K EXPERT

A new 128K microcomputer, which Exleigh Business Machines have called the "Expert", has just arrived in the UK from Sord Computer Systems in Tokyo.

Based on the Z80A microprocessor, the "Expert" has a 128K byte internal memory, which is memory mapped. It has a monitor with a 12 inch screen and 2 x 320K disk drives. There are two RS232 ports and one parallel printer port. It also has a full ASCII keyboard.

For the standard package of the "Expert" the end-user price is £1950 which also includes, the CBASIC language and the new high level language called PIPS (Pan Information Processing System) which has been designed in Japan for the "Expert".

PIPS is said to be ideal for the non-programmer. It consists of about 100 commands for formating and entering the user's own data to suit his own particular requirements. The aim of PIPS is to bring computing skills to the average businessman who is without programming knowledge.

PIPS enables an operator to format and tabulate data, perform calculations and sorting routines with a single key instruction.

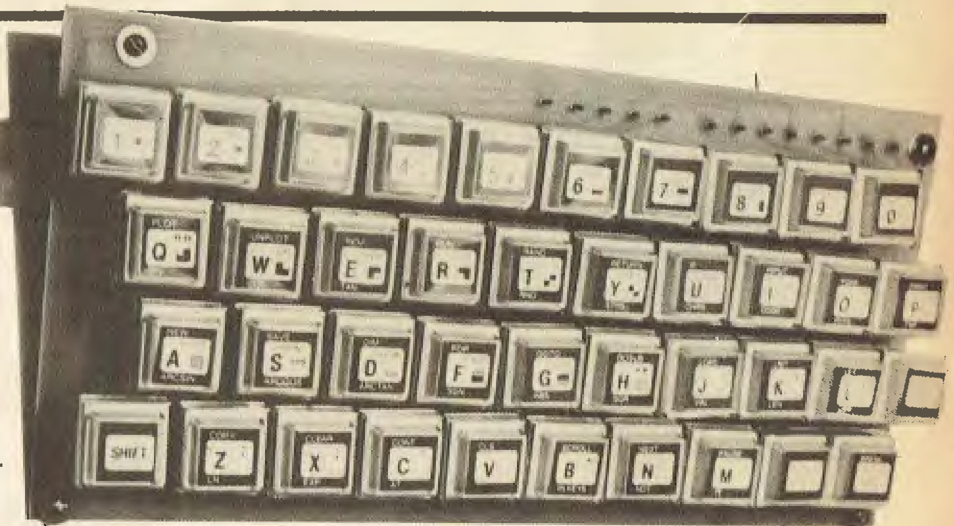
When a colour monitor is connected to the "Expert" PIPS can be displayed in the colour of the user's choice with varying backgrounds to identify specific information. The colour monitor costs £515.

The new PIPS language has achieved great acclaim in Japan and is expected to become popular in the UK.

For further information: contact Exleigh Business Machines Ltd., 11 Market Place, Penzance, Cornwall, Tel: 0736 66577.

NEXT MONTH

In Britain's first electronics & computer applications magazine



LOW COST COMPUTER KEYBOARD

This project explains how to build a low cost detacheable keyboard for the ZX-81. With a bit of luck this project will help the thousands of users who experience difficulties keying instructions into the 81.

REAL TIME CLOCK FOR THE MICROTAN 65

The basic design of this project is for the Microtan system using the I/O area facilities thus making the clock invisible to the system until required. It is built around the Real Time Clock IC from R.S. Components. A printed circuit board is also available for this project.

THE BIG MEMORY MACHINE

The Archives 111 is reviewed by the well known author Chris Bidmead. Chris takes a critical look at this machine which while no one pretends it to be in the home computing range it will be of considerable interest to readers who have more ambitious computing plans in mind.

VIC-20 Special feature

A review of the Arfon expansion unit and applications report on the Vic will feature in this issue.

ON SALE 12th March

The Sirius 16-bit Personal Computers

The ACT Sirius 1 is a third generation 16-bit personal computer specifically designed for business. At a price of £2,395 for the basic system which ACT claim is one of the best price/performance ratios available for a personal computer.

Developed by Chuck Peddle, formerly of Commodore and generally recognised as the father of personal computing, the ACT Sirius has 128 Kbytes semiconductor memory as standard, with plug-in modules taking it up to 512 Kbytes. It comes complete with a 1.2 Mbyte twin floppy drive, video monitor and detachable keyboard in an attractive ergonomic package.

It has a wide range of software and two operating systems, CP/M-86 and the IBM specified MSDOS open up a large library of existing applications programs. For software houses there is a wide choice of languages - compiled BASIC, COBOL, PASCAL, and FORTRAN. Microsoft's BASIC 80 is supplied as standard. In addition Micro-Modeller and Wordstar packages are available on the ACT Sirius along with ACT's own PULSAR accounting system.

ACT are the sole distributor of the Sirius in the UK and Eire. They will provide a field engineering service and maintain a comprehensive stock of parts. A network of 100 business system dealers will support the Sirius at a local and regional level. First deliveries of the Sirius to end users will be February.

For further information contact Chris Buckham 021 454 8585.

VIC 20 Expansion System

Arfon Microelectronics have not wasted any time in launching an expansion unit for the VIC 20. The unit comprises of a seven cartridge fully integrated system housed in an aluminium shell the same colour as the VIC. The system has its own power supply which will also meet the requirements of a printer being developed by Arfon, which it is hoped will retail for less than £100.

Memory cartridges are available with a choice of 3K (2 Eprom sockets) 8K or 16K RAM cartridges which will fit the VIC 20 alone or fit into the expansion board.

All the products described are approved by Commodore. The expansion system will retail for £85 plus VAT and the memory cartridges 3K-£26, 8K-£39, 16K-£65.

For further details:
Contact Arfon Microelectronics Ltd., Cibyn Industrial Estate, Caernarfon, Gwynedd, Wales.

Low Cost Daisy Wheel Printers

AMBAR Components Limited have just come to an agreement with Olivetti Peripheral Equipment (O.P.E.) to supply, from stock, a range of daisy wheel printers, floppy disc drives and hard disc (Winchester) drives.

Low cost daisy wheel printers, first patented in 1969 and produced in volume since 1975, have 13 inch or 17 inch platens, print bi-directionally at 20 or 30 characters per second in high quality word processor standard, and have Centronics or RS 232/V24 interface as standard. Other interface options are available. THE MODEL NUMBERS ARE DY 211 AND DY 311.

Floppy disc drives have been in mass production since 1974 and O.P.E. are recognised as a leader in this field with production running in excess of 50 thousand units per year. AMBAR are stocking 5¼" drives with soft or hard sectoring, single or double sided, single or double density 125 to 500K bytes, unformatted storage with standard ANSI/Shugart interface. THE MODEL NUMBERS ARE FD 501 AND FD 502.

Winchester-type fixed magnetic disc drives are available in two types, the first is a 5¼" with 7.5 megabytes storage and Seagate interace; the second type is a first for the U.K. and is available NOW from Ambar, a 5¼" Winchester with INTEGRAL TAPE BACK-UP, 12.3 megabytes storage and Multibus, LSI 11, S 100 interfacing. THE MODEL NUMBERS ARE HD 561 AND HDB 513.

Data and pricing information are available from Ambar Components Limited, at 0296 34141, Telex 837427.

WATFORD ELECTRONICS

33/35, CARDIFF ROAD, WATFORD, HERTS WD1 8ED, ENGLAND
Tel. Watford (0923) 40588. Telex: 8956095 WAELEC

ALL DEVICES BRAND NEW. FULL SPEC. AND FULLY GUARANTEED. ORDERS DESPATCHED BY RETURN OF POST. TERMS OF BUSINESS: CASH/CHEQUE/P.O.s OR BANKERS DRAFT WITH ORDER. GOVERNMENT AND EDUCATIONAL INSTITUTIONS OFFICIAL ORDERS ACCEPTED (TELEPHONE ORDERS BY ACCESS NOW ACCEPTED Minimum £10.00 please), TRADE AND EXPORT INQUIRY WELCOME. P & P ADD 50p TO ALL ORDERS UNDER £10.00 EXCL. VAT. OVERSEAS ORDERS POSTAGE AT COST.

VAT Export orders no VAT. Applicable to U.K. Customers only. Unless stated otherwise, all prices are exclusive of VAT. Please add 15% to the total cost incl. p&p.
We stock many more items. It pays to visit us. We are situated behind Watford Football Ground. Nearest Underground/Br. Rail Station: Watford High Street. Open Monday to Saturday 9 a.m.-6 p.m. Ample Free Car Parking space available.

POLYESTER CAPACITORS: (Axial Lead) 400V: 1nF, 1n5, 2n2, 3n3, 4n7, 6n8 **11p**; 10n, 15n, 18n, 22n **12p**; 33n, 47n, 68n **16p**; 100n, 150n **20p**; 220n **30p**; 330n **42p**; 470n **52p**; 680n **60p**; 1µF **68p**; 2µ2, 4µ7 **85p**. **160V:** 10nF, 12n, 100n **11p**; 150n, 220n **17p**; 330n, 470n **30p**; 680n **38p**; 1µF **42p**; 1µ5 **46p**; 2µ2 **48p**; 4µ7 **58p**. **1000V:** 1nF **17p**; 10nF **30p**; 15n **40p**; 22n **38p**; 33n **42p**; 47n, 100n **50p**.

POLYESTER RADIAL LEAD CAPACITORS: 250V: 10n, 15n, 22n, 27n **6p**; 33n, 47n, 68n, 100n **7p**; 150n, 220n **10p**; 330n, 470n **13p**; 680n **19p**; 1µ **23p**; 1µ5 **40p**; 2µ2 **46p**.

ELECTROLYTIC CAPACITORS (Values in µF). **500V:** 10 **52p**; 47 **78p**; **63V:** 0.47, 1.0, 1.5, 2.2, 3.3, **8p**; 4.7 **9p**; 6.8, 10 **10p**; 15, 22 **12p**; 33 **15p**; 47 **12p**; 100 **19p**; 1000 **70p**; **50V:** 47 **12p**; 68 **20p**; 220 **24p**; 470 **32p**; 2200 **90p**; **40V:** 4.7, 15, 22, **9p**; 330 **50p**; 4700 **120p**; **25V:** 1.5, 6.8, 10, 22 **8p**; 33 **9p**; 47 **8p**; 100 **11p**; 150 **12p**; 220 **15p**; 330 **22p**; 470 **25p**; 680, 1000 **34p**; 2200 **50p**; 3300 **76p**; 4700 **92p**; **16V:** 40, 47, 100 **9p**; 125 **12p**; 220 **13p**; 470 **20p**; 680 **34p**; 1000 **27p**; 1500 **31p**; 2200 **36p**; 3300 **74p**; 4700 **79p**.

TAG-END TYPE: 70V: 4700 **245p**; **64V:** 3300 **196p**; 2200 **139p**; **50V:** 3300 **154p**; 2200 **110p**; **40V:** 4700 **160p**; **25V:** 10,000 **320p**; 15,000 **345p**.

TANTALUM BEAD CAPACITORS:
35V: 0.1µ, 0.22, 0.33 **15p**; 0.47, 0.68, 1.0, 1.5 **16p**; 2.2, 3.3 **18p**; 4.7, 6.8 **22p**; 10 **28p**; **16V:** 2.2, 3.3, **16p**; 4.7, 5.8, 10 **18p**; 15 **38p**; 22 **30p**; 33, 47 **40p**; 100 **75p**; 220 **88p** **10V:** 15, 22 **26p**; 33, 47 **35p**; 100 **55p**.

SILVER MICA (pF)
2, 3, 4.7, 6.8, 8.2, 10, 12, 18, 22, 27, 33, 39, 47, 50, 56, 68, 75, 82, 85, 100, 120, 150, 180 **15p each**
220, 250, 270, 330, 360, 390, 470, 600, 800 & 820pF **21p each**
1000, 1200, 1800 **30p each**
3300, 4700 **60p each**

SIEMENS multilayer miniature capacitors.
250V: 1nF, 1n5, 2n2, 3n3, 4n7, 6n8, 8n2, 10n, 12n, 15n, 22n **7p**; 18n, 27n, 33n, 47n **8p**; 39n, 56n, 68n **9p**. **100V:** 100n, 120n, **10p**; 150n **11p**; 220n **13p**; 330n **18p**; 470n **23p**; 680n **30p**; 1µF **34p**; 2µ2 **50p**.

MYLAR Film CAPACITORS
100V: 1nF, 2n, 4n, 4n7, 10 **5p**
15nF, 22, 30, 40, 47n **7p**
56nF, 100, 200n **9p**
50V: 470nf **12p**

POLYSTYRENE Caps:
10pF to 1nF **8p**
1n5 to 12nF **10p**

CERAMIC Capacitors: 50V
Range 1pF to 6800pF **4p**
10nF, 15n, 22, 33, 47nF **5p**
100nf/30V **7p**; 220nf/6V **8p**.

Sound Generator
AY-3-8910 **£6**
Special Booklet for above **£2.50**

POTENTIOMETERS: Carbon Track, 0.25W Log & Linear Values.
500Ω, 1K & 2K (LIN ONLY) Single **29p**
5KΩ-2MΩ single gang **29p**
5KΩ-2MΩ single gang D/P switch **78p**
5KΩ-2MΩ dual gang stereo **88p**
1W Wire-wound 50Ω-20K **115p**

SLIDER POTENTIOMETERS
0.25W log and linear values 60mm track
5KΩ-500KΩ Single gang **70p**
10KΩ-500KΩ Dual gang **110p**
Self-Stick graduated Alum. Bezels **40p**

PRESET POTENTIOMETERS
0.1W 50Ω-2.2M Mini Vert. & Horiz. **7p**
0.25W 100Ω-3.3MΩ Horiz. larger **10p**
0.25W 250Ω-4.7MΩ Vert. **10p**
Precision Cermet 1W 100Ω-100K **60p**

RESISTORS—Hi-stab, Miniature, 5%, Carbon.

RANGE		Val.	1-99	100+
0.25W	2Ω2-4.7M	E24	2p	1p
0.5W	2Ω2-4.7M	E12	2p	1p
1W	2Ω2-10M	E12	5p	3p
2% Metal Film	10Ω-1M		6p	4p
1% Metal Film	51Ω-1M		8p	6p

100+ price applies to Resistors of each type not mixed values.

LINEAR IC's

555 CMOS	60
702	75
709C 8 pin	35
710	48
741	14
747C 14 pin	65
748C 8 pin	36
753 6 pin	185
810	159
9400CJ	350
AY-1-0212	675
AY-1-1313A	660
AY-1-1320	225
AY-1-5050	99
AY-1-5051	160
AY-1-6720	210
AY-3-1270	840
AY-3-8500	390
AY-3-8810	600
AY-3-8912	625
AY-5-1224A	235
AY-5-1230	450
AY-5-1317A	630
AY-5-4007D	520
AY-5-8100	775
CA3011	110
CA3012	175
CA3014	157
CA3018	68
CA3019	70
CA3020	186
CA3023	191
CA3028A	120
CA3035	236
CA3036	115
CA3043	275
CA3045	385
CA3046	70
CA3048	214
CA3059	223
CA3075	213
CA3080E	65
CA3081	190
CA3086	40
CA3089E	215
CA3090AQ	375
CA3123	150
CA3130	90
CA3140	48
CA3160	95
CA3161E	135
CA3162E	450
CA3189	200
CA3240	110
HA1336W	240
ICL7106	750
ICL7107	975
ICL8038CC	300
ICL8211	450
ICM7204	550
ICM7205	1150
ICM7207	475
ICM7215	1050
ICM7216A	1950
ICM7216B	1950
ICM7217A	790
ICM7224	785
ICM7555	80
ICM7556	00
LA3350	250
LA4031P	340
LA4032	295
LA4400	440
LC7120	300

LC7130	340
LF347	150
LF351	48
LF355	85
LF356	95
LF357	110
LM10	425
LM301A	26
LM308	95
LM311	70
LM318	200
LM319	215
LM324	30
LM335	128
LM339	54
LM348	64
LM349	115
LM358	65
LM377	175
LM379	480
LM394	320
LM725CN	325
LM733	100
LM379	415
LM380	75
LM381N	145
LM382	125
LM384	140
LM386	90
LM387	120
LM389	95
LM393	100
LM394CH	290
LM2917	195
LM3302	96
LM3900	50
LM3909	85
LM3911	125
LM3914	210
LM3915	220
LM3916	220
LM13600	125
LS7220	280
M252AA	625
M253AA	1150
M51513L	230
M51515L	220
MB3756	440
MC1303	88
MC1304P	260
MC1310P	150
MC1445	150
MC1458	40
MC1494	694
MC1495	350
MC1496L	70
MC1596	225
MC1648	290
MC1709G	90
MC3302	150
MC3340P	120
MC3360P	120
MC3401	65
MC3403	110
MC3405	150
MC4016	00
MFC6040	97
MK50398	835
MM5303	635
MM5307	1275
MM5387A	475
MSM5526	820
NE515	275
NE529	225
NE531	140
NE543	225

NE544	210
NE555	16
NE556DB	45
NE560	325
NE561	395
NE552B	410
NE564	420
NE565A	120
NE566	155
NE567	140
NE570	425
NE571	420
NE5534	150
RC4136D	69
S5668	245
SAB3209	426
SAB3210	295
SAB3271	475
SAB4209	595
SAS560	150
SAS570	150
SL490	350
SG3402	295
SN76003N	350
SN76013N	350
SN76023N	350
SN76033	350
SN76115N	215
SN76131	125
SN76227N	95
SN76477	175
SN76660	120
SP8629	299
TA7120	150
TA7130	160
TA7204	225
TA7205	220
TA7222	175
TA7310	175
TAA621AX1	295
TAA661A	190
TAA700	275
TAA900	00
TAA960	00
TAD100	159
TBA540	275
TBA120S	70
TBA550Q	330
TBA641-A12/BX1 or BX11	350
TBA651	190
TBA800	80
TBA810S	85
TBA820	80
TBA920Q	290
TBA950	300
TBA990	350
TCA270	350
TCA940	175
TCA965	120
TDA1004	290
TDA1008	310
TDA1022	530
TDA1024	105
TDA1034	250
TDA1490	290
TDA2002	325
TDA2020	320
TDA2030	320
TDB0791	420
TL061CP	40
TL062CP	60
TL064CN	98
TL071CP	30
TL072CP	50
TL074CN	100

TL081CP	25
TL082CP	45
TL083CP	75
TL084CP	95
TL091CP	65
TL170	50
UA2240	245
UAA170	170
UAA180	170
UAA1003-3	935
ULN2003	85
ULN2004	90
ULN2283	100
UPC575	350
UPC1025H	375
UPC1182	330
UPC1156H	280
XR2206	300
XR2207	375
XR2211	575
XR2216	675
XR2240	245
XR2266	750
ZN414	88
ZN419CE	190
ZN423E	138
ZN424E	130
ZN425E-8	345
ZN426E-8	300
ZN427E-8	600
ZN428E	478
ZN429E-8	210
ZN1034E	200
ZN1040E	675

COMPUTER IC's

1702	299
1802CP	700
2101-2	110
2112-2	250
2114L-300n	87
2114L-200n	87
2118-4	250
2147-3	425
2532-450n	450
2564	£20
2708	175
2716-5V	210
2732-450n	400
2764	£19
4027	240
4116-150	95
4116-200	75
4118-250	400
4164-200	620
4315-4K	795
4334-3 (CMOS 2114)	325
4864-3 64K	785
6115-3 CMOS RAM	500 / 700
6502 CPU	399
6503	600
6504-250	550
6505	600
6520 PIA	175
6521	150
6522 VIA	350
6530 RRIOT	1350
6532 RIOT	670

6545 CRTC	1460
6551 ACIA	785
6592 PC	£20
6800	300
6602	400
6803	£12
6804	160
6805	670
6808	520
6809	999
6810	160
6820	175
6821	125
6840	420
6843	£14
6845	975
6847	850
6850	160
6852	255
6875	500
8080A	350
8085A	550
81LS95	90
81LS96	90
81LS97	90
8166	00
8195	125
8202	£25
8212	170
8214	425
8216	70
8224	200
8226	260
8228	250
8251	320
8253	799
8255	295
8257	800
8T26A	99
8T27	150
8T28A	115
8T31	350
8T95N	99
8T97N	99
9364AP	550
AM26LS31C	125
AM26LS32A	125
AY-3-1015	300
AY-5-1013	300
AY-5-2376	600
FD1771	£18
IM6402	380
MC1488	55
MC1489	55
MC14411	595
MC14412	795
MM5280D	895
RO-3-2513L	700
RO-3-2513U	600
SFF96364E	800
SFC71301	820
TMS2716-3V	875
TMS6011	365
ULN2003	100
Z80CPU 2.5	385
Z80ACPU 4M	385
Z80 P10	290
Z80A P10	320
Z80 CTC	300
Z80A CTC	325
Z80DMA	999
Z80S10-1	£15
Z80AS10	£23
Z80 DART	728
Z80A DART	775

TRANSISTORS

AC107	35
AC125/6	35
AC127/8	30
AC141/2	30
AC176	28
AC187/8	32
ACY17/18	70
ACY19/20	75
ACY21/22	75
ACY28	75
AD142	120
AD149	79
AD161/2	42
AF118	95
AF139	40
AF178	75
BC107/8	10
BC107B	12
BC108	10
BC108B	12
BC108C	12
BC109	10
BC109B	12
BC109C	12
BC117/8	20
BC140/42	30
BC143	30
BC147/8	9
BC147B	10
BC148B	10
BC148C	10
BC149	9
BC149C	12
BC153/4	27
BC157/8	10
BC159	11
BC160	45
BC167A	10
BC168C	10
BC169C	10
BC170	15
BC171/2	11
BC173	11
BC177/8	20
BC179	20
BC181	20
BC182/3	10
BC184	10
BC182L	10
BC183L	10
BC184L	10
BC187	26
BC212/3	10
BC212L	10
BC213L	10
BC214	10
BC214L	10
BC237/8	14

BC307B	14
BC308B	16
BC327/8	15
BC337/8	15
BC441	34
BC461	34
BC477/8	40
BC516/7	40
BC547/8	14
BC549C	14
BC556/7	15
BC558/9	15
BCY70	16
BCY71/2	20
BD121	95
BD124	115
BD131/2	48
BD133	60
BD135	45
BD136/7	40
BD138/9	40
BD140	40
BD144	198
BD205	110
BD245	45
BD378	70
BD434	55
BD517	75
BD695A	99
BD696A	99
BDY56	160
BDY60	160
BF115	35
BF167	29
BF173	27
BF177	25
BF178	30
BF179	35
BF180	38
BF194/5	12
BF196/7	12
BF198	16
BF199	18
BF200	30
BF224	25
BF244A	28
BF244B	28
BF256B	35
BF257/8	32
BF259	35
BF274	42
BF336	40
BF451	35
BF594	30
BF595	39
BFR39/40	23
BFR41/79	23
BFR60/81	25
BFR98	105

BFX29/84	28
BFX85/86	28
BFX87/88	28
BFY50/51	23
BFY52	23
BFY56	32
BFY64	35
BFY81	120
BFY90	80
BRY39	40
BSX20	20
BSX29	34
BSY95A	25
BU105	170
BU108	240
BU109	210
BU205	190
BU206	200
BU208	200
E421	250
MDB001	250
MJ2955	90
MJE340	54
MJE370	100
MJE371	100
MJE520	95
MJE2955	99
MJE3055	70
MPF102	66
MPF103	36
MPF104	36
MPF105	36
MPF106	40
MPSA05	25
MPSA06	25
MPSA12	32
MPSA55	30
MPSA56	30
MPSA70	30
MPSU02	58
MPSU05	55
MPSU06	55
MPSU52	85
MPSU55	60
MPSU56	60
OC23/26	170
OC26	130
OC36	120
OC41/42	120
OC44	120
OC45/70	40
OC71/72	40
OC76	50
OC81/82	50
OC83/84	40
OC170/1	85
DC200	85
TIP29A	38
TIP29C	52
TIP30A	48

TIP30C	58
TIP31A	45
TIP31C	55
TIP32A	48
TIP32C	60
TIP33A	65
TIP33C	76
TIP34A	74
TIP34C	88
TIP35A	160
TIP35C	185
TIP36A	170
TIP36C	199
TIP41A	55
TIP41B	60
TIP42A	60
TIP42B	75
TIP120	90
TIP121	99
TIP141	120
TIP142	120
TIP147	120
TIP2955	60
TIP3055	60
TIS43	32
TIS44/45	45
TIS48	50
TIS88A	50
TIS90	30
TIS91/93	32
UC734	65
VK101D	60
VN10KM	45
VN46AF	78
VN66AF	85
VN88AF	94
ZTX107/8	11
ZTX109	12
ZTX212	28
ZTX300	13
ZTX301/2	16
ZTX303	25
ZTX304	17
ZTX314	25
ZTX320/26	30
ZTX341	30
ZTX500/1	14
ZTX502/3	18
ZTX504	25
ZTX531	25
ZTX550	25
2N696	30
2N697	23
2N698	40
2N699	48
2N706A	19
2N708	19
2N914/5	32
2N918	35
2N930	20

2N1131/2	24
2N1303/4	65
2N1305/7	60
2N1308	68
2N1613	30
2N1671B	160
2N2160	295
2N2219A	28
2N2220A	26
2N2221A	28
2N2222A	25
2N2369A	18
2N2646	45
2N2846	60
2N2904	28
2N2905A/8	26
2N2907A	26
2N2926G	10
2N3053	26
2N3054	58
2N3055	48
2N3442	140
2N3565	15
2N3614	199
2N3615	199
2N3663	15
2N3702/3	10
2N3704/5	10
2N3706/7	10
2N3708/9	10
2N3710	10
2N3711	10
2N3771	179
2N3772	195
2N3773	270
2N3819	22
2N3820	45
2N3822/3	65
2N3866	90
2N3903/4	18
2N3905	15
2N3906	17
2N4037	46
2N4058	10
2N4061/2	10
2N4069	45
2N4427	80
2N4859	78
2N4871	55
2N5135/5	20
2N5138	18
2N5172	18
2N5179	45
2N5180	45
2N5191	75
2N5194	80
2N5305	24
2N5457	36
2N5458/9	36
2N5485	36

2N5777	45
2N6027	32
2N6109	60
2N6290	70
2SA715	60
2SC495	70
2SC496	70
2SC1096	85
2SC1172	125
2SC1173	125
2SC1306	150
2SC1307	220
2SC1449	65
2SC1678	140
2SC1923	50
2SC1945	225
2SC1953	90
2SC1957	90
2SC1969	198
2SC2028	85
2SC2029	200
2SC2078	175
2SC2091	85
2SC2314	85
2SC2166	165
2SC1679	190
2SD234	76
2SK45	90
3N128	112
3N140	112
40097	88
40100	215
40101	130
40250	85
40251	97
40311	80
40313	130
40315	60
40316	95
40317/20	80
40360	40
40361/62	50
40406	75
40407	80
40408	70
40411	285
40412	66
40457	130
40468	85
40594	105
40595	110
40603	110
40636	175
40673	95

74S Series

74S132	138
74S133	60
74S136	210
74S168	210
74S189	158
74S194	360
74S201	350
74S225	525
74S241	540
74S262	850
74S287	300
74S288	210
74S289	290
74S387	300
74S470	325
74S471	620
74S472	1150
74S475	825
74S571	620

75 Series

75107	95
75110	115
75108	360
75150	126
75154	150
75182	115
75183	115
75188	85
75189	65
75322	165
75450	95
75451/2	70
75454	225
75491/2	70

TTL 7400 (TEXAS)

7400	11
7401	11
7402	11
7403	14
7404	14
7405	18
7406	28
7407	28
7408	15
7409	15
7410	14
7411	20
7412	20
7413	24
7414	32
7416	25
7417	25
7420	16
7421	20
7422	20
7423	22
7425	26
7426	30
7427	27
7428	28
7430	16
7432	26
7433	27
7437	27
7438	27
7440	17

7441	58
7442	38
7443	90
7444	90
7445	65
7446	56
7447	50
7448	50
7450	16
7451	16
7453	16
7454	16
7460	16
7470	35
7472	30
7473	30
7474	25
7475	40
7476	30
7480	48
7481	120
7482	70
7483	50
7484	80
7485	95
7486	25
7489	205
7490	28
7491	45
7492	30
7493	30
7494	34
7495	50
7496	45
7497	120
74100	85
74104	54
74105	65
74107	32
74109	35
74110	40
74111	55
74112	170
74116	88
74118	80
74119	90
74120	76
74121	30
74122	45
74123	50
74125	42
74126	40
74128	42
74132	48
74136	35
74141	70
74142	190
74143	250
74144	250
74145	70
74147	99
74148	75
74150	80
74151	45
74153	45
74154	75
74155	75
74155	75
74157	45
74159	99
74160	60
74161	60
74162	62
74163	64
74164	64
74165	62
74166	55
74167	185
74170	168
74172	290

74173	65
74174	72
74175	72
74176	65
74177	75
74178	95
74179	68
74180	65
74181	140
74182	75
74184	99
74185	99
74186	290
74190	70
74191	70
74192	70
74193	65
74194	75
74195	65
74196	65
74197	65
74196	99
74199	99
74221	80
74246	150
74247	150
74248	150
74249	150
74251	80
74259	195
74265	65
74273	195
74276	150
74278	160
74279	90
74283	90
74284	199
74285	199
74290	105
74293	125
74297	236
74298	100
74351	195
74365	55
74366	55
74367	55
74368	55
74390	99
74393	99
74490	120

74LS

LS00	12
LS01	13
LS02	14
LS03	14
LS04	15
LS05	16
LS06	15
LS08	15
LS09	15
LS10	16
LS11	15
LS12	15
LS13	30
LS14	48
LS15	15
LS20	15
LS21	15
LS22	15
LS26	18
LS27	15
LS28	20
LS30	18
LS32	15
LS33	16
LS37	16
LS38	16
LS40	16

LS42	35
LS47	40
LS48	80
LS49	60
LS51	15
LS54	15
LS55	30
LS63	150
LS73	25
LS74	25
LS75	28
LS76	20
LS78	24
LS83	50
LS85	70
LS86	38
LS90	35
LS91	80
LS92	36
LS93	36
LS95	45
LS96	120
LS107	43
LS109	30
LS112	30
LS113	40
LS114	35
LS122	44
LS123	55
LS124	105
LS125	30
LS126	30
LS132	45
LS133	35
LS136	28
LS138	35
LS139	38
LS145	75
LS147	199
LS148	99
LS151	39
LS153	39
LS155	39
LS156	39
LS157	35
LS158	38
LS160	41
LS161	41
LS162	41
LS163	41
LS164	48
LS165	145
LS166	85
LS168	85
LS170	170
LS173	72
LS174	72
LS175	58
LS181	130
LS183	275
LS190	58
LS191	58
LS192	58
LS193	65
LS194	40
LS195	40
LS196	58
LS197	85
LS200	345
LS202	345
LS221	80
LS240	96
LS241	96
LS242	85
LS243	85
LS244	80
LS245	90
LS247	40
LS248	65
LS249	68

LS251	40
LS253	40
LS257	48
LS258	40
LS259	85
LS260	21
LS261	196
LS266	25
LS273	90
LS275	290
LS279	88
LS280	250
LS283	45
LS290	57
LS293	46
LS295	215
LS298	130
LS299	420
LS300	175
LS302	175
LS320	270
LS323	270
LS324	200
LS325	320
LS326	330
LS327	315
LS347	150
LS348	190
LS352	185
LS353	185
LS355	37
LS366	37
LS367	37
LS368	90
LS373	76
LS374	75
LS375	48
LS377	90
LS378	69
LS379	65
LS384	395
LS385	378
LS390	62
LS393	60
LS395	199
LS399	220
LS445	140
LS471	520
LS490	245
LS541	135
LS640	225
LS641	225
LS645	210
LS668	175
LS669	150
LS670	175
LS673	550
LS674	750

CMOS

4000	14
4001	14
4002	14
4006	66
4007	18
4008	62
4009	35
4010	40
4011	15
4012	18
4013	34
4014	75
4015	66
4016	32
4017	48
4018	68
4019	42
4020	61
4021	70
4022	68

4023	20
4024	45
4025	19
4026	130
4027	38
4028	58
4029	77
4030	50
4031	170
4032	125
4033	185
4034	195
4035	95
4038	275
4037	115
4038	110
4039	290
4040	59
4041	78
4042	60
4043	70
4044	65
4045	170
4046	75
4047	75
4048	55
4049	30
4050	30
4051	78
4052	78
4053	78
4054	125
4055	125
4056	120
4057	1915
4059	480
4060	90
4061	1226
4062	995
4063	99
4066	36
4067	399
4068	22
4069	20
4070	26
4071	20
4072	20
4073	20
4075	20
4076	60
4077	26
4078	26
4081	26
4082	21
4085	65
4086	70
4089	140
4093	43
4094	168
4095	90
4096	90
4097	320
4098	88
4099	95
4160	95
4161	99
4162	99
4163	99
4174	99
4175	105
4194	105
4408	790
4409	790
4410	725
4411	695
4412	800
4415	480
4419	280
4422	770
4433	770

4435	850
4440	999
4450	350
4451	350
4490	350
4500	675
4501	28
4502	90
4503	50
4504	105
4506	65
4507	40
4508	265
4510	68
4511	68
4512	75
4513	199
4514	195
4515	198
4516	75
4517	415
4518	42
4519	29
4520	78
4521	200
4522	125
4526	95
4527	115
4528	80
4529	150
4530	90
4531	130
4532	110
4534	500
4536	295
4538	115
4539	115
4541	140
4543	135
4544	150
4549	395
4553	299
4554	190
4555	50
4556	55
4557	320
4558	120
4559	395
4560	180
4561	104
4562	495
4566	175
4568	250
4569	175
4572	36
4580	460
4581	250
4582	99
4583	99
4584	48
4585	99
4597	330
4598	290
4599	595
40097	88
40100	215
40101	130
40102	180
40103	175
40104	95
40105	115
40106	75
40107	60
40108	450
40109	100
40110	300
40114	240
40163	108
40193	108
45106	595

SPEAKERS
8Ω, 0 3W, 2": 2·25", 2·5", 3" **60p**
0 3W, 2 5" 40Ω; 64Ω or 80Ω **80p**

DIODES	
AA119	15
BA100	15
BY100	24
BY126	12
BY127	12
CRO33	250
OA9	40
OA47	12
OA70	12
OA79	15
OA85	15
OA90	8
OA91	8
OA95	8
OA200	8
OA202	8
1N914	4
1N916	5
1N4001/2	5
1N40D3	8
1N4004/5	6
1N4006/7	7
1N4148	4
1N5401	15
1N5404	16
1N5406	17
1N5408	19
1S44	9
1S921	9
6A/100V	40
6A/400V	50
6A/800V	66

BRIDGE RECTIFIERS (plastic case)	
1A/50V	20
1A/100V	22
1A/400V	29
1A/600V	34
2A/50V	36
2A/200V	40
2A/400V	46
2A/600V	65
6A/100V	83
6A/400V	95
6A/600V	125
10A/200V	215
10A/600V	350
25A/200V	240
25A/600V	395
BY164	56
VM18	50

ZENERS
Range: 2V7 to 39V 400mW **8p each**
Range: 3V3 to 33V, 1 3W **15p each**

Noise Diode
Z5J **195**

VARICAPS	
MVAM2	185
MVAM115	158
BA102	30
BB105B	40
BB106	40

SCR's Thyristors	
0·8A-100V	32
1A/200V	58
1A/400V	70
5A/300V	38
5A/400V	40
5A/600V	46
8A/300V	60
8A/600V	95
12A/100V	78
12A/400V	95
12A/800V	188
BT106	150
BT116	160
C106D	38
TIC44	24
TIC45	29
TIC47	35
2N5062	32
2N5064	38
2N4444	130

DIAC
ST2 **25**

TRIACS	
3A/100V	48
3A/400V	56
3A/800V	85
8A/100V	60
8A/400V	89
8A/800V	115
12A/100V	78
12A/400V	82
12A/800V	135
18A/100V	103
16A/400V	105
16A/800V	220
25A/400V	185
25A/800V	295
25A/1000V	460
30A/400V	525
T2800D	120
2N5777	45
4N33	135
OCP71	120
ORP12	68
ORP61	95

OPTO ELECTRONICS

LEDS including Clips	
TIL209 Red 125"	13
TIL211 Green 125"	18
TIL212 Yellow	18
TIL220 2" Red	15
0 2" Yel, Grn, Amber	18
Red, Green and Yellow Rectangular LEDs.	29
Triangular LEDs R&G	18
0 2" Flashing LED Red	55
0 2" Bi colour LEDs Red/Green	85
Green/Yellow	65
0 2" Tri colour LEDs Red/Green/Yellow	85
0·2" Red High Bright	59
LD271 Infra Red (emit)	46
TIL32 Infra Red (emit)	52
SFH205 (detector)	91
TIL78 (detector)	54
TIL100	90

7 Segment Displays

TIL321 5" C.An	115
TIL322 5" C.th	115
DL704 3" C.Cth	99
DL707 3" C.Anod	99
DL747 6" C.Cathod.	180
8" Orange C.A.	250
FND357 or 500	120
3" Green C.A.	140
±1 3" Red or Green	150
Bargraph 10 seg. Red	225

FERRIC CHLORIDE
1 lb bag Anhydrous **195p** + 50p p&p

DALO ETCH RESIST
Pen + Spare tip **90p**

0·5" LIQUID CRYSTAL DISPLAYS
3½ digit **550**
4 digit **850**
6 digit **750**

NEONS
Red or Amber Round or Square **30p each**

OPTO SWITCH
Reflective TIL139 **170**
Slotted similar to RS **186**

ALUM. BOXES	
3x2x1"	65
4x2¼x2"	85
4x2¾x2¼"	103
4x4x2½"	120
5x4x2	105
5x2½x1½"	90
5x2½x2¼"	130
5x4x1½"	95
5x4x2½"	120
6x4x2"	120
6x4x3"	150
7x5x3"	180
8x6x3"	210
10x4½x3"	240
10x7x3"	275
12x5x3"	280
12x8x3"	295

SPECIAL OFFER

	1+	50+
NE555	16p	14p
2114L-3	87p	80p
2114L-2	87p	80p
2708	175p	160p
2532	450p	375p
2716	210p	195p
2732	400p	375p
4116	75p	68p
6116	580p	550p
6522	350p	320p
7805 1A/5V	45p	35p

CUSTOMER: How can Watford sell full spec devices so cheaply?
WATFORD: It's simple. By bulk buying (direct from manufacturers where possible), low overheads and smaller margins which give us an edge over our competitors.

COPPER CLAD BOARDS

Fibre Glass	Single-sided	Double-sided	SRBP
6"x6"	90p	110p	9·5"x8 5" **95p**
6"x12"	150p	195p	

SOLDERCON PINS
100 pins **70p** 500 pins **325p**

VEROBOARDS 0 1"

	Clad	Plain
2½x3¾"	73p	52p
2½x5"	63p	—
3¾x3¾"	83p	—
3¾x5"	95p	79p
3¾x17"	325p	211p
4¾x18"	425p	—
Pkt. of 100 pins	50p	
Spot Face Cutter	118p	
Pin Insertion Tool	182p	

'VQ' Board	150
'DIP' Board	330
Vero Strip	144
S100 Board	£14

PROTO-DECs

Veroblock	375
S-Dec	350
Eurobreadboard	520
Bimboard 1	695
Superstrip SS2	1350

VERO WIRING PEN and Spool **310p**
Spare Wire (Spool) **75p**; Combs **6p** ea.

ANTEX Soldering Irons

C15W	410
CX17W	425
CCN15W	425
X25W	440
Spare bits	50
Elements	200
Iron stands	160
Heat Shunt	25

Buy with Access

Just phone your order through, we do the rest.

GAS & SMOKE DETECTORS
TGS812 & 813 **575**
Sockets **40**

ULTRASONIC TRANSDUCERS
40KHz Transmitter & Receiver **395p/pair**

DIL SOCKETS (TEXAS)

	Low profile	Wire wrap
8 pin	8p	25p
14 pin	10p	35p
16 pin	10p	42p
18 pin	16p	52p
20 pin	22p	60p
22 pin	25p	70p
24 pin	25p	70p
28 pin	28p	80p
36 pin	—	105p
40 pin	30p	99p

DIL PLUGS (Headers)

14 pin	44
16 pin	49
24 pin	88
40 pin	255

Ribbon Cable ft.
10 way **22p**
24 way **50p**

SPEAKING CLOCK
Full Kit of parts now available **Only: £37.50**

ZERO Insertion Force DIL Sockets
24 way **595p**; 28 way **850p**; 40 way **975p**

'D' CONNECTORS
mini.(Cannon type) Solder Bucket

	Plugs	Sockets	Covers plastic
9 way	95p	125p	145p
15 way	136p	198p	150p
25 way	170p	230p	130p
37 way	290p	398p	185p
PCB Pins 25 way	200p	245p	—
PCB Pins (right angle) 25 way	210p	275p	—

Amphenol Plugs
24 way IEEE **575p**
36 way Centonic Parallel **550p**

EDGE CONNECTORS
Two rows

	·1	·156
2x10 way	—	135p
2x15 way	—	140p
2x18 way	180p	145p
2x22 way	199p	200p
2x25 way	225p	220p
2x30 way	245p	—
2x36 way	295p	—
2x40 way	315p	—
2x43 way	395p	—

WATFORD'S Ultimate Monitor IC.

A 4K Monitor Chip specially designed to produce the best from your: Superboard Series I & II, Enhanced Superboard & UK101. As reviewed by Dr. A. A. Berk In Practical Electronics, June 1981.
Price only £15.95 + 50p P&P.

EPSON MX Series PRINTERS
Now available from stock at very competitive prices.

- **MX80T** 10" Tractor Feed, 9x9 matrix, 80 column Speed 80 CPS bi-directional, Centronics Interface, Baud rate 110-9600 (RS232) **£340**
- **MX80FT** Has Friction & Tractor Feed plus all the MX80T's facilities **£375**
- **MX80FT2** Has high resolution Graphics option plus all the MX80FT's facilities **£420**
- **MX100** 132 Column plus all the facilities of MX80FT2. Value for money. **£550**

TRANSFORMERS (mains Prim. 220-240V) 6-0-6V 100mA; 9-0-9V 75mA; 12-0-12V 75mA **98p**
6VA type: 6V- 5A 6V- 5A; 9V- 4A 9V- 4A; 12V- 3A 12V- 3A; 15V- 25A 15V- 25A **220p**
12VA: 4·5-1·3A 4·5V-1 3A; 6V-1 2, 6V-1 2A 12V- 5A 12V- 5A **275p** (30p p&p)
24VA: 6V-1 5A 6V-1 5A; 9V-1 2A 9V-1 2A; 12V-1A 12V-1A, 15-·8A 15-·8A; 20V- 6A 20V-·6A **320p** (44p p&p)
50VA: 6V-4A 6V-4A; 9V-2·5A 9V-2·5A; 12V-2A 12V-2A; 15V-1·5A 15V-1·5A; 20V-1·2A 20V-1·2A; 25V-1A 25V-1A; 30V-·8A 30V-·8A **395p** (60p p&p)
100VA: 12V-4A 12V-4A; 15V-3A 15V-3A; 20V-2·5A 20V-2·5A; 30V-1·5A 30V-1·5A; 40V-1·25A 40V-1·25A; 50V-1A 50V-1A **920p** (60p p&p)
(N.B. P&P charge to be added above our normal postal charge).

JUMPER LEADS Ribbon Cable Assembly
Single ended DIP, 24" length Cable
14 pin **145p** 16 pin **165p**;
24 pin **240p**; 40 pin **380p**.
Double ended DIP

	14 pin	16 pin	24 pin	40 pin
6"	185p	205p	300p	485p
12"	198p	215p	315p	490p
24"	210p	235p	345p	540p
36"	230p	250p	375p	595p

COMPUTER CORNER

- **VIC 20 MICROCOMPUTER.** Connects directly to a colour TV. 5K RAM expandable to 32K PET type graphics. **£165**
- **CASSETTE DECK** for VIC20 including a free 6 programme Cassette. **£34**
- **EPSON MX SERIES PRINTERS:** see top right hand side of this advertisement.
- **SEIKOSHA GP80A** – Unihammer Printer, gives normal and double width characters as well as dot resolution graphics 8" Tractor feed. Parallel Interface standard. **£195**
- **SOFTY–2.** As reviewed in PE September 1981. The complete microprocessor development system for Engineers & Beginners. New powerful instruction. Accepts any 24 pin 5V single rail EPROM. Supplied fully built, tested & enclosed in a black ABS case. Price incl. encapsulated plug in power supply. **£169**
- **VIDEO MONITOR** 9" fully cased. B&W. Fully guaranteed. Excellent value for money at only **£69**
- **TEX EPROM ERASER.** Erases up to 32 ICs in 15-30 min. **£33**
- **TEX EPROM ERASER** with integral 30 min. Electronic timer **£45**
- **Spare** 'UV lamp bulbs **£9**
- **5V/5A PSU** Ready built and tested **£25**
- Attractive Beige/Brown **ABS CASE** for Superboard/UK101 or Home Brew **£26**
- **Extra 4K of RAM** (8 off 2114L-300nS) **£7**
- **Space Invaders** for Superboard **£6**
- **Full ASC11** coded keyboard type '756' **£39**
- **4 x 4 matrix keypad** (reed switch assembly) **£4**
- **C12 Cassettes** in Library Cases **40p**
- **8½ Fan fold paper** (500 sheets) (no VAT) **£6**
- **9½" Fan fold paper** (500 sheets) (no VAT) **£6**
- **Teleprinter Roll** (no VAT) **£3.50**

(P&P on most of the above items is extra)
Call in at our shop for demonstration of any of the above items. Be satisfied before you buy.

VOLTAGE REGULATORS

1A	T03 +ve		-ve	
5V	7805	145p	7905	220p
12V	7812	145p	7912	220p
15V	7815	145p	7915	220p
18V	7818	150p		
1A	TO220 Plastic Casing			
5V	7805	50p	7905	65p
12V	7812	60p	7912	65p
15V	7815	50p	7915	55p
18V	7818	50p	7918	65p
24V	7824	60p		
100mA	TO92 Plastic Casing			
5V	78L05	30p	79L05	60p
6V	78L62	30p		—
8V	78L82	30p		—
12V	78L12	30p	79L12	60p
15V	78L15	30p	79L15	60p

		LM309K	135
LM300H	170	LM309KP	99
LM304H	160	LM317H	280
LM305H	140	LM317K	350
78H05 5V/5A	550p	LM323K	500
78HG+5 to +24V 5A	599p	LM326N	240
		LM327N	270
79HG –2.25V to –24V 5A	785p	LM723	35
		TBA625B	75

SWITCHES

SLIDE 250V

1A DPDT	14
1A DPDT C/OFF	15
½A DP on/on/on	40

TOGGLE 2A 250V

SPST	33
DPDT	44
4 pole on/off	54

PUSH BUTTON
Spring loaded

Latching or Momentary 6A SPDT c/over	99
DPDT c/over	145

MINIATURE Non Locking

Push to make	15p
Push break	25p

SUB-MIN TOGGLE

SP changeover	80
SPST on off	54
SPDT c/off	85
SPDT Biased	105
DPDT 6 tags	75
DPDT C/OFF	88
DPDT Biased	145
3 pole c/over	205

ROCKER: 5A, 250V SPST **28p**
ROCKER: (white) 10A 250V SPDT **38p**
ROCKER: With neon lights red when on. 10A 250V, DPST **85p**
ROCKER: (White) 10A/250V DPDT **72p**
ROTARY: Make your own Multiway Switch. Shafting Assembly accommodates up to 6 wafers. **90p**
Break before make Wafers. Silver contacts 1 pole/12 way: 2 pole/6 way: 3 pole/4 way: 4 pole/3 way: 6 pole/2 way **65p**
Mains DPST Switch to fit **45p**
Screen & Spacers **6p**
ROTARY: (Adjustable Step Type) 1 pole/2 to 12 way, 2p/2 to 6 way, 3 pole/2 to 4 way, 4 pole/2 to 3 way **45p**
ROTARY: Mains 250V AC, 4 Amp **58p**
DIL SWITCHES: (SPST) 4 way **70p**; 6 way **85p**; 8 way **90p**; 10 way **145p**; (SPDT) 4 way **190p**.

CRYSTALS

32 768KHz	100
100KHz	270
200KHz	295
455KHz	370
1MHz	295
1 28MHz	392
1 6MHz	396
1 8MHz	395
1 008M	290
1 8432M	220
2 0MHz	240
2 4576M	220
3 2768M	220
3 57954M	150
3 6864M	300
4 0MHz	200
4·032MHz	290
4 80MHz	200
4 194304M	200
4·433619M	120
5 0MHz	200
5·185MHz	300
5 24288M	390
6 0MHz	220
6·144MHz	240
6·5536MHz	200
7 0MHz	200
7 168MHz	250
7 68MHz	200
8 0MHz	200
8 08333M	395
8 867237M	240
9 00MHz	200
9 375MHz	350
10 0MHz	200
10 7MHz	220
10 24MHz	200
12 0MHz	290
12 528MHz	300
14 31818M	320
16 0MHz	250
18 0MHz	240
18 432M	240
19 968MHz	325
20 0MHz	325
24 0MHz	200
24 930MHz	325
26 69M	290
26·670MHz	325
27 648M	330
27 145M	240
27 125MHz	295
38 66667M	290
48 0MHz	270
100 0MHz	375
116 0MHz	300

ASTEC UHF Modulators

6MHz	280
8MHz Wide-bandwidth	425

WATFORD'S UNIVERSAL MICRO EXPANSION SYSTEM

Designed by Watford Electronics, this extremely versatile and economical Expansion System as published in E.T.I., starting from Dec., 81 issue, offers a low cost flexible expansion facility for **ZX81**, UK101, SUPERBOARD, ACORN ATOM, PET, TANGERINE, VIDEO GENIE, ECT.

The Motherboard (Interfaces with the Computer) has capacity to accept up to five daughter cards and can be paralleled for even more daughter cards.

All PCBs are of Computer grade finish and are supplied in Kit form.

Just look at the expansion possibilities:

MOTHERBOARD – Accepts up to five Daughter Cards **Full Kit: £36.50**

SOUND CARD – Utilising up to three AY-3-8910 Sound chips. (one supplied with every Kit) **Full Kit: £24.95**

PIO CARD – Using two 6520 PIA chips, this Board offers Centronics parallel printer driver, digital to analogue converter and a host of other out-put facilities. **Full Kit: £19.95**

PROM PROGRAMMER – This simple but extremely useful card can blow 2716 or 2732 single rail EPROMS. **Full Kit: £19.95**

PROM CARD – P.C.B. cards for housing four 2716 or two 2732 EPROMS.
(4x2716) **Full Kit: £9.95**
(2x2732) **Full Kit: £9.75**

RAM CARD – 8K RAM card. Accepts 16x2114 RAMs. The Board is supplied fully populated. **Full Kit: £28.50**

(N.B. PCBs may be bought separately)

WATFORD ELECTRONICS
Tel. (0923) 40588 Telex. 8956095

COMPUTER INT SLIDE PROJECT

Information is that which enables us to make decisions. It may take a variety of forms: numeric, textual, sonic and pictorial. The most familiar of these is probably numeric. As humans, our inability and dislike of handling this class of information was one of the prime motivations, many years ago, for the development of the digital electronic computer. Techniques for numeric information processing via computers are now well established. In many areas of application such as automatic process control, scientific analysis, simulation, and computer aided design/manufacture the prominent role of the computer is most apparent.

Over the last decade computer technology has turned its attention to yet another form of information — words and text. Advances in the power of both microcomputer systems and data storage techniques have been combined to produce a multitude of document, text and word processing systems. Like numeric computation, text handling is now a standard facility on most micros. By means of appropriate software packages it is possible to keep (and periodically update) address lists, compose essays or letters and analyse text for authorship and style.

Currently, there is "teeming" activity in yet a third area of information processing — graphics. Graphic information may take many different forms. Broadly, however, these fall into two fundamental categories — based upon either static or animated images. These may originate from two possible sources. Either they may be generated by a computer program or captured by some form of camera. Independently of their source these images may be stored on an appropriate storage medium and then retrieved for display via a suitable screen device. Presently, there is much interest in computer systems able to process pictorial information of this type — either internally (as in robot vision systems) or externally (as in image retrieval applications).

Graphic images may be stored externally on numerous types of storage device — for example, slides, cinefilm, videotape and optical disk. The first of these offers an easy, inexpensive way of storing static graphical images. The latter three media provide increasingly sophisticated image storage techniques that offer the possibility of handling both static and dynamically changing scenes. Combined with appropriate computer technology these external image storage devices have a variety of uses. Undoubtedly, slide projection equipment is the least costly and probably most readily available. In the remainder of this article we describe the use of a microcomputer for controlling the display of images retrieved from one or more slide projectors.

Use of Slide Projectors

Pictorial communication through the medium of slides is a powerful means of disseminating information. Because of the large amount of highly resolved detail that can be contained in a picture, this type of communication channel has a high bandwidth for information transfer. For this reason slides are often used to supplement lectures on scientific and technical topics. Other information dissemination activities such as computer aided learning and computer based aiding systems also frequently employ slide presentation techniques in order to supplement material presented via a VDU screen. In addition slides are often widely used for advertising and sales promotion — particularly when automated display systems can be set up and left running without a human operator.

Computer based training and aiding systems that involve the use of slide images will require a facility that enables the interconnection of their embedded microcomputer to the external picture projection equipment. In order to achieve this some form of hardware/software interface is required — as depicted in **Figure 1**. Microcomputer peripherals are usually interconnected by means of one of the internationally accepted interfacing standards. The most popular of these are the RS-232C, IEEE-488, CAMAC, S-100 and so on. Unfortunately, there are no commonly agreed upon standards for the interfacing of "exotic" peripherals such as slide projectors — video tapes or videodisks. In view of this arbitrary non-standard interfaces often have to be used. The basic function of the interface is to convert control signals produced by the computer into a form that are acceptable to and which can be handled by the slide projector. Obviously, the detailed design of the interface will depend upon the nature of both the microsystem and the slide projector(s) to which it is to be interfaced.

Most modern slide projectors depend upon the use of some form of slide storage

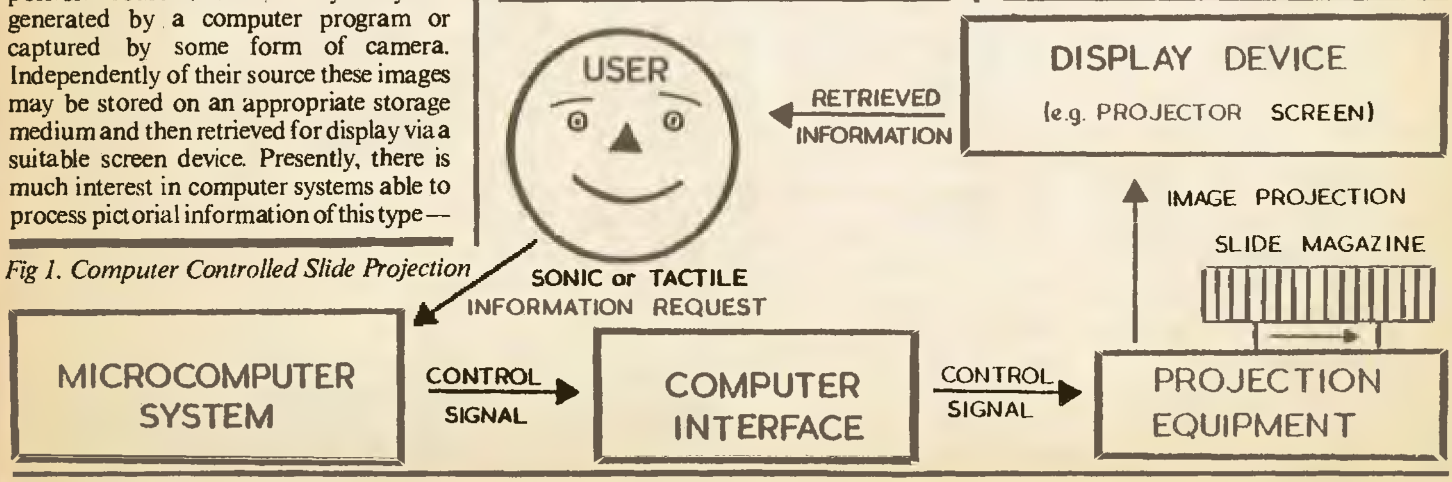


Fig 1. Computer Controlled Slide Projection

ERFACES FOR ORS

by Philip G. Barker

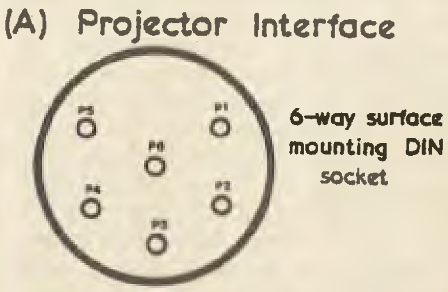
magazine. These are usually capable of holding from 50 to 100 images. The Kodak CAROUSEL S-AV2000, for example, can hold up to 80 slides in its circular magazine. Projectors of this kind will undoubtedly offer facilities that permit the use of a remote "hand-held" controller. Typically, this consists of a series of push-button switches mounted on a small keypad. The switches control the motion of the slide magazine (either forward or backward) and also provide a means of focussing. The wires running from the remote controller are cabled into the projector by means of a multiway plug that is inserted into a matching socket mounted on the projector.

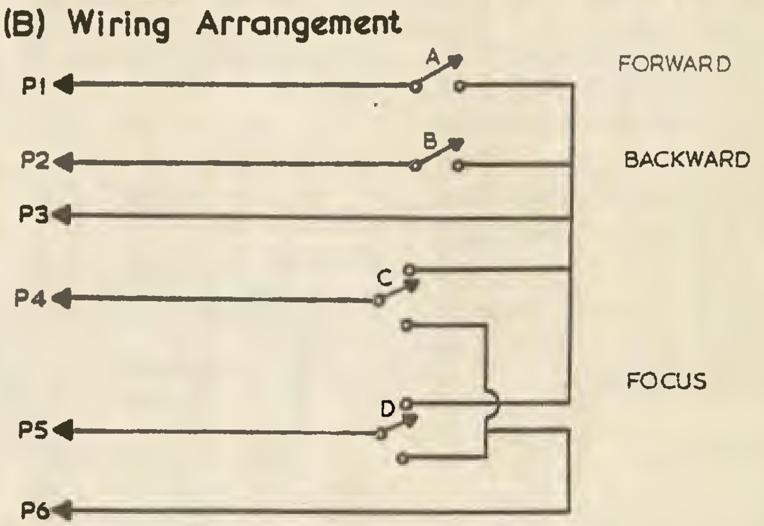
The wiring scheme of a typical remote control keypad (that of the Kodak CAROUSEL S-AV2000 is depicted in **Figure 2.** Essentially, it is constructed from four simple switches. The first of these, A, causes the slide magazine to be moved forward one position each time it is pressed. B, the second switch, has the opposite effect. Switches C and D, together, are responsible for focussing the projected image.

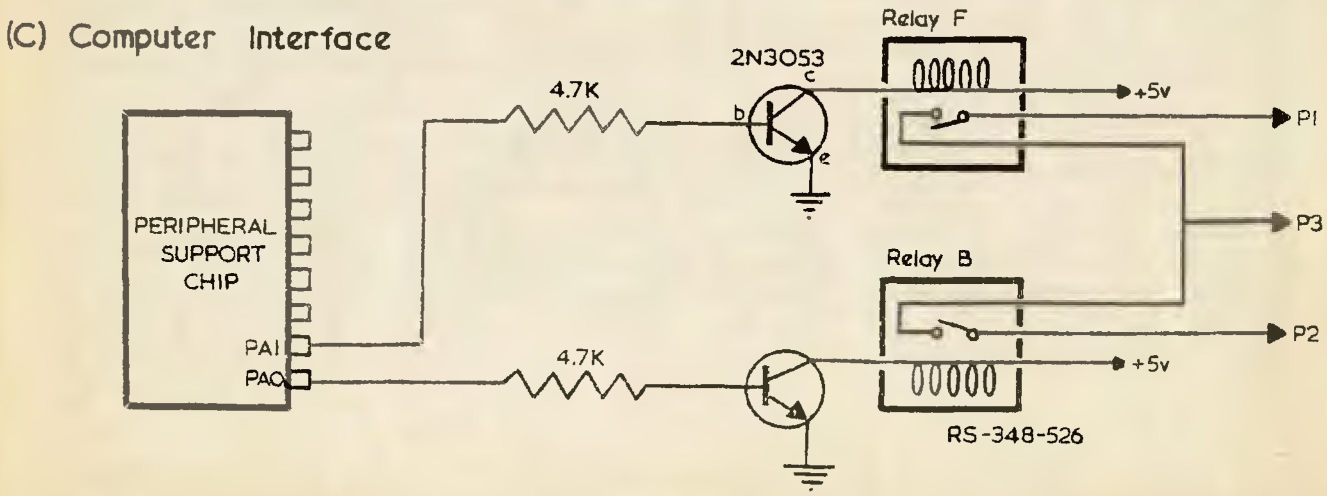
When designing a computer interface for the type of projector described above the remote control socket provides an easy way of introducing the computer generated control signals. By suitably inter-connecting lines P1, P2 and P3 it is possible to replace switches A and B by two equivalent computer controlled relay switches. Once this has been done it is a simple matter to operate these under software control via a suitable output port on the microcomputer. Most of these provide TTL signals that can be used to activate a transistor circuit that is designed to provide sufficient drive power to operate the external relay. Such a circuit is shown in the lower part of **Figure 2.**

Typical computer I/O ports may be based upon IC chips such as the INS8255N PIA, MOS 6522 VIA, MC6821P PIA or the Z80A P10 — depending upon the microcomputer system used. We have used a MOS technology 6522 VIA embedded in a PET host system to drive our relays. This provides 8 I/O lines that may thus be used to drive up to four slide projectors. ▶

Fig 2. Remote Controller for a Slide Projector







Sequential Projection

Based upon their repertoire of image retrieval strategies slide projectors may be categorised as belonging to one or other of two general classes. The first, and simplest, of these represents those projectors that are only able to operate in a sequential access mode. Projectors in the second class are more versatile. Members of this category are able to provide their user with the capability of randomly retrieving and displaying images. However, projectors of this type require a more sophisticated interface than that outlined above. In view of this, they will be discussed in more detail in the next section.

Controlling a single sequential projector by computer is a fairly straight-forward matter once the hardware interface has been constructed. Assuming that the interface connections are brought out through lines PA0 and PA1 of the PET User Port (see **Figure 2**) the program shown in figure 3A will enable a user to control the action of the projector. The PET keyboard is used as an input device. Typing the letter F causes the magazine to advance to the next slide while typing the letter B results in a backspace operation thereby enabling the previous slide to be viewed. Two control subroutines are provided. That at lines 300 through 380 is responsible for generating a pulse to activate relay F within the interface. The other, at lines 400 through 480 generates a pulse to activate relay B. This program and interface have been extensively used to control a Kodak S-AV2000 projector.

The major limitation of a simple single projector configuration lies in its small storage capacity — 80 slides. The system could be expanded to handle 320 images by attaching a further three projectors. However, for many applications this too may be insufficient. Storage limitations of this type can easily be overcome by modifying the interface circuit in such a way that it expands the I/O capability of the User Port. A suitable modification is shown in figure 4. It is based on the use of eight SN74LS175 quad storage latches (D-type flip-flops) and a SN74LS138 3-to-8 decoder/demultiplexer chip. The latter is used to generate latch enable signals. User Port utilisation is as follows: PA0, PA1 and PA2 are used as a simple 3-bit address bus that specifies which latch (and hence, projector) is to be enabled: each latch services two projectors. Pins PA4, PA5, PA6 and PA7 act as a simple four-bit data bus whose contents are used to update the enabled latch. The CS2 line is used to produce a clock pulse which causes the selected latch to be updated on its low to high transition.

Using this circuit up to sixteen projectors can now be controlled thereby providing a capacity for as many as 1280 slides. The control program for such an arrangement is shown in figure 3B. The user enters the projector number (in the range 1 through 16) and, as before, the required direction of magazine rotation — F or B. Notice that the interface arrangement shown in **Figure 4** provides the ability to project up to sixteen images simultaneously. By means of more sophisticated programming techniques it becomes feasible to produce a variety of interesting graphic effects by super-imposing several different images. For example, it would be possible to build up complex pictures from much simpler ones or decompose compound scenes into their component parts. Techniques such as this offer valuable tools for computer based training and aiding applications.

Random Projection

Sequential presentation of images is a useful techinque when the information to be displayed is highly ordered and no departures from a linear access scheme are

Fig 4. Hardware Interface for Controlling 16 Projectors

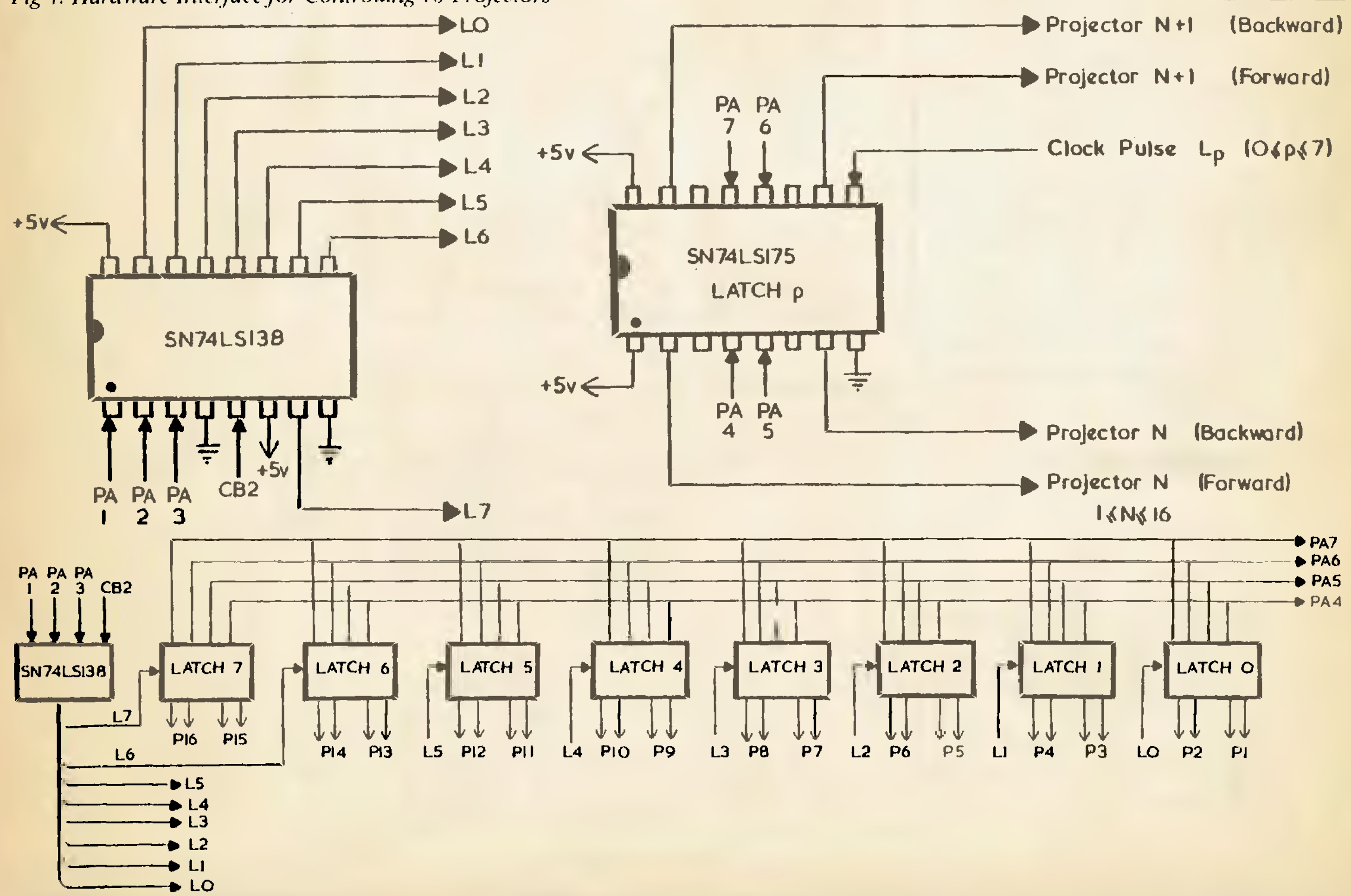


Figure 3 Control Programs for Sequential Slide Projectors

(A) Single Projector

```
100 POKE 59459,3
110 POKE 59471,0
120 PRINT "□↓↓↓ SEQUENTIAL SLIDE
     PROJECTION"
130 PRINT "↓↓ →→F ADVANCES MAGAZINE"
140 PRINT "↓ →→B SHOWS PREVIOUS SLIDE"
150 REM GET USER'S REQUIREMENT
160 GET A$ : IF A$ = " " THEN 160
170 IF A$ = "F" OR A$ = "B" THEN 190
180 GOTO 160
190 IF A$ = "F" THEN GOSUB 300
200 IF A$ = "B" THEN GOSUB 400
210 GOSUB 160
300 REM MOVE MAGAZINE FORWARD
310 X = PEEK (59471)
320 X = X OR 1
330 POKE 59471,X
340 K = TI
350 IF TI < K + 20 THEN 350
360 X = X AND NOT 1
370 POKE 59471, X
380 RETURN
400 REM MOVE MAGAZINE BACKWARD
410 X = PEEK (59471)
420 X = X OR 2
430 POKE 59471,X
440 K = TI
450 IF TI < K + 20 THEN 450
460 X = X AND NOT 2
470 POKE 59471,X
480 RETURN
```

required. However, there are many situations where this mode of usage is not applicable. In many real-time image retrieval systems, for example, it is never possible to anticipate (with any certainty) the order in which images will need to be displayed. As an example of this, consider the use of image projection as a means of augmenting the learning processes involved in computer based training systems.

Suppose someone is to be trained in the use of microelectronics. Typically, under computer control a slide projector might be used to show a trainee some slides containing pictures of electronic components and circuit diagrams in which these are used. Then, the computer would attempt to assess the trainee's understanding of the material by requesting the answer to a multiple choice question that it displays on its VDU screen. Assume that this has six single valued response options — say A, B, C, D, E and F. Once the student has responded to the question the computer may be required to execute the following type of decision logic:

If reply is A then show slide N;
If reply is E or C or B then show slide K;
If reply is D or F then show slide P;
If HELP requested then go to HELPER;
Go to INVALID-REPLY routine;

Obviously, to implement this kind of image presentation strategy in an effective way a random access slide projector is a necessary pre-requisite.

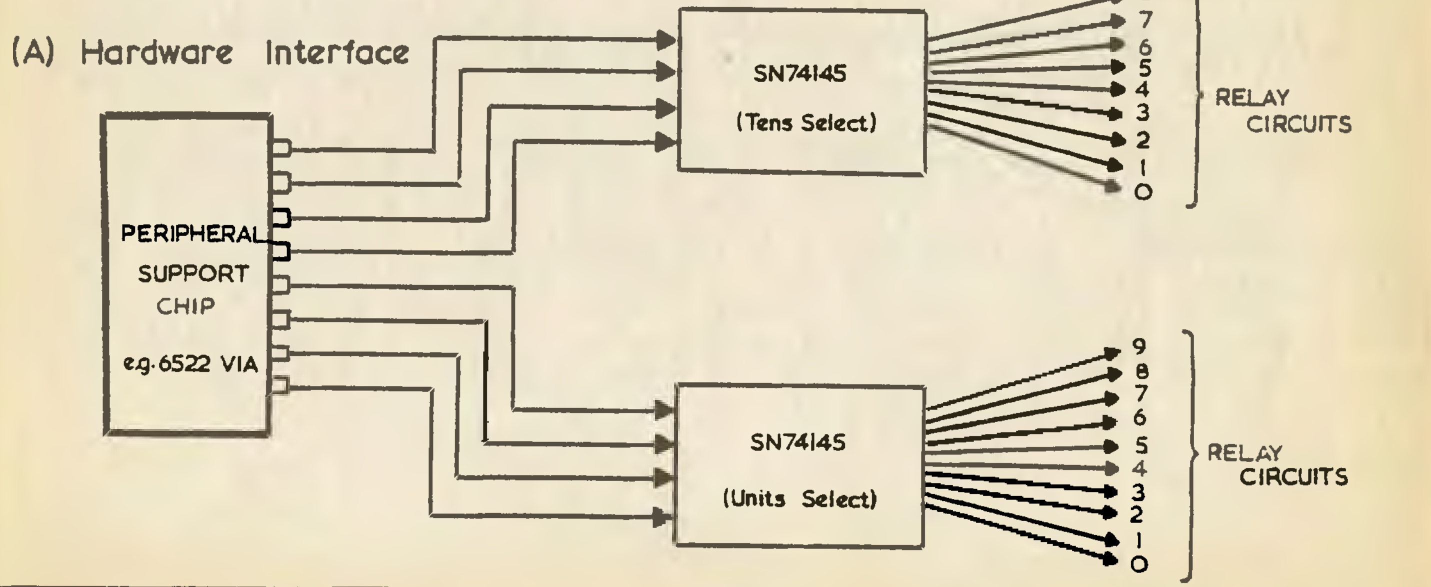
Commercial projectors of this type, such as the Kodak CAROUSEL S-RA2000, are usually fitted with numeric keypads. These enable their user to "key-in" the decimal number of the slide that is to be retrieved and displayed. This number represents the actual sequential position of the slide in the storage magazine. Once it has been keyed-in the projector rapidly retrieves the slide and projects it. The time to retrieve an image is less than five seconds — no matter where it resides within the magazine. Thus, with this type of projection equipment any sequence of slides can be rapidly displayed without the need to physically re-position them — as would be necessary in the case of a sequential projector. Unfortunately, however, the design and construction of computer interfaces for random access projectors is more difficult since they place a greater demand on the I/O port of the host microcomputer — as will be described below.

The way in which the remote decimal keypad controller of the Kodak RA projector operates is fairly easy to understand. It may be likened to two banks of switches — A and B. Bank A, consisting of nine switches, selects the "tens digit" of the slide number, bank B, containing ten switches, then selects the "units digit". The slide to be retrieved can now be specified by closing just two switches, one in bank A (range 0 to 8) and one in bank B (range 0 to 9). This logic is fairly easy to emulate through the use of two SN74145 BCD-to-Decimal decoder chips as shown in **Figure 5A**. The relay circuits used are similar to ▶

(B) Software for Interface Control

```
10  POKE 59459,255
20  INPUT "□○↓↓↓↓÷ENTER SLIDE NUMBER"; NS
30  IF NS>80 THEN 90
40  IF NS<0  THEN 90
50  K=INT(NS/10)*16+NS-INT(NS/10)*10
60  POKE 59471,K
70  GOTO 20
90  PRINT "↓↓INVALID SLIDE NUMBER SELECTED"
100 PRINT "TRY AGAIN"
105 K2=TI
106 IF TI<K2+120 THEN 106
110 GDTO 20
```

Fig 5. Control of a Random Access Slide Projector



those employed in the case of the sequential projector shown in **Figure 2.** Notice that each SN74145 IC requires four input lines. Together they require the use of all eight I/O lines of the microcomputer output port. This is a severe limitation if other devices also need to use this for I/O. However, as will be described later, it is a fairly easy matter to overcome this limitation.

A simple control program to operate the random access slide projector is shown in **Figure 5B**. Its logic is quite straightforward. The slide number typed in by the user is transformed from decimal to two BCD digits. The resultant bit pattern is then sent out via the Pet User Port to the pair of decoder chips housed in the interface. These then activate appropriate relay circuits which now emulate the effect of the normal remote numeric keypad controller. The projector retrieves the specified image and displays it.

A more sophisticated application of the projector is embodied in the program listed in **Figure 6**. This software enables it to be programmed to show any sequence of slides over and over again — as many times as its user requires. The time for which any particular slide image is displayed can be set to a default value or uniquely specified. This system has been used for a variety of automated demonstrations and advertising applications.

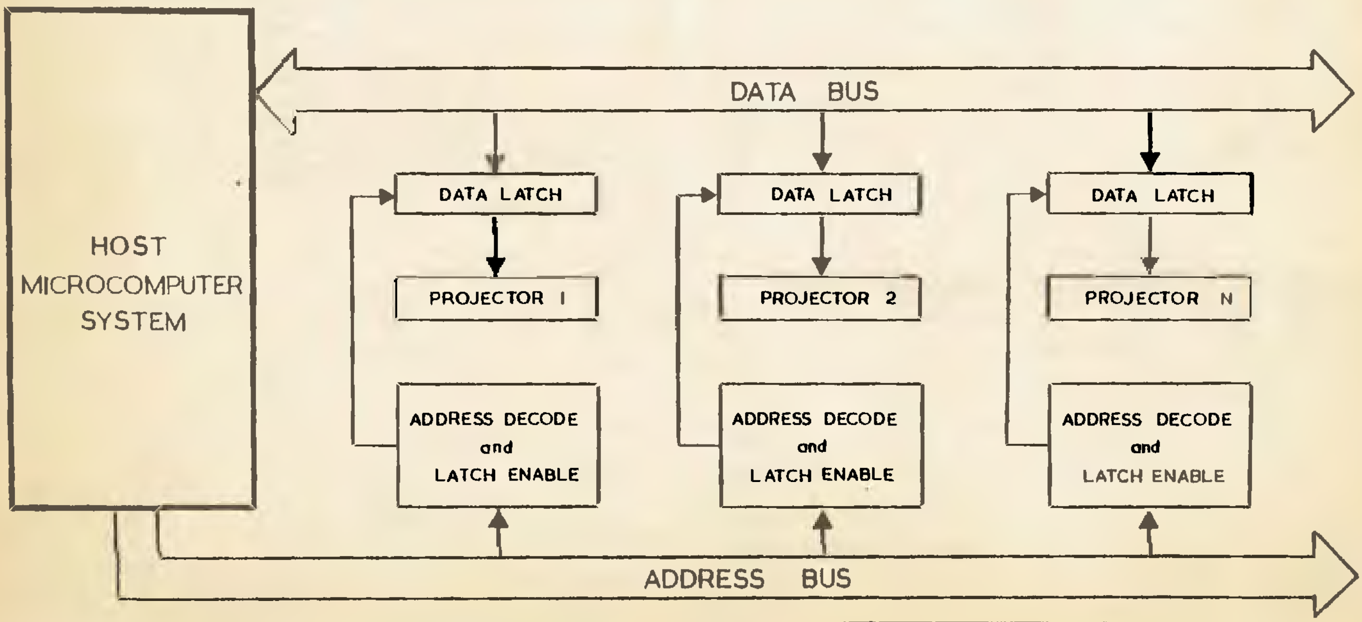
Should the need arise to control a significant number of random access projectors then, because of the limitation mentioned above, an alternative addressing scheme needs to be found. The User Port cannot be used because this is dedicated to the transfer of switch selection data. The microcomputer address bus provides one solution to this problem. By equipping each projector with an address decoder/latch enable circuit it becomes possible to memory map the projectors onto the address space of the computer. Then, the User Port can be used as a common data bus from which the data is strobed by the projector whose identification is sent over the address bus. If the User Port is not available (because it is being employed to control other devices) the PET's bi-directional data bus could be used to transmit the slide selection data. This arrangement is shown schematically in **Figure 7**. When using this approach to projector control, the BASIC statement POKE X,Y could be used to request that slide Y be displayed on the projector whose address is X. Memory mapping of projectors onto unused ROM addresses within the PET can thus be used to provide sufficient expansion capability to support any reasonable number of slide projectors without placing any demands on the User Port. An analogous strategy could be used to control the sequential projectors described in the previous section.

CONTINUED ON PAGE 34

FIG 3 (B) Multiple Projectors

```
100 REM CONTROL OF MULTIPLE SLIDE
    PROJECTORS
110 REM ****************************
120 REM
130 GOSUB 390 : REM INITIALISE SYSTEM
140 INPUT "□↓↓ PROJECTOR NUMBER";N
150 IF N < 1 OR N > 16 THEN 140
160 INPUT "↓↓FORWARD OR BACKWARD"; D$
170 IF D$ = "F" OR D$ = "B" THEN 200
180 PRINT "↑↑↑";
190 POKE 32989,32 : GOTO 160
200 REM CALCULATE WHICH LATCH TO USE
210 L = INT ( (N-1)/2)
220 REM NOW CALCULATE DATA VALUE
230 REM ASSUME FORWARD MOTION
240 V = 1
250 IF D$ = "B" THEN V = 2
260 REM SEE IF EVEN OR ODD PROJECTOR
    NUMBER
270 REM ASSUME ODD TO START
280 SF = 1
290 IF N = INT(N/2)*2 THEN SF = 4
300 REM CALCULATE VALUE OF DATA WORD
310 V = V*SF
320 REM SEND PULSE TO PROJECTOR
330 GOSUB 490
340 K = TI
350 IF TI < K + 20 THEN 350
360 V = 0
370 GOSUB 490
380 GOTO 140
390 REM ***INITIALISE SYSTEM
400 POKE 59459,255
410 X = PEEK (59468)
420 X = X OR 128 OR 64 OR 32
430 POKE 59468,X
440 FOR L = 0 TO 7
450 V = 0 : REM CLEAR LATCHES
460 GOSUB 490
470 NEXT I
480 RETURN
490 REM ***UPDATE OUTPUT LATCH
500 D = V*16 + L
510 POKE 59471,D
520 POKE 59468,(PEEK(59468) AND NOT 32)
530 POKE 59468,(PEEK(59468) OR 32)
540 RETURN
```

Fig 7. Memory Mapped Random Access Slide Projector



VIDEO GENIE WITH 2K EPROM

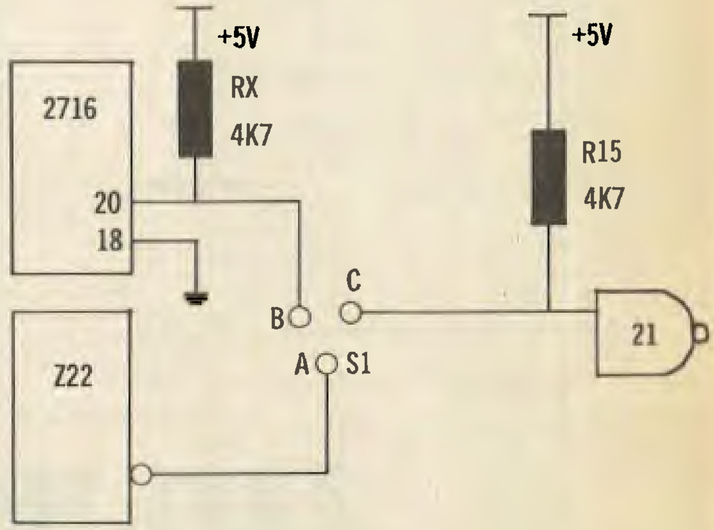
by Jay Lazzari

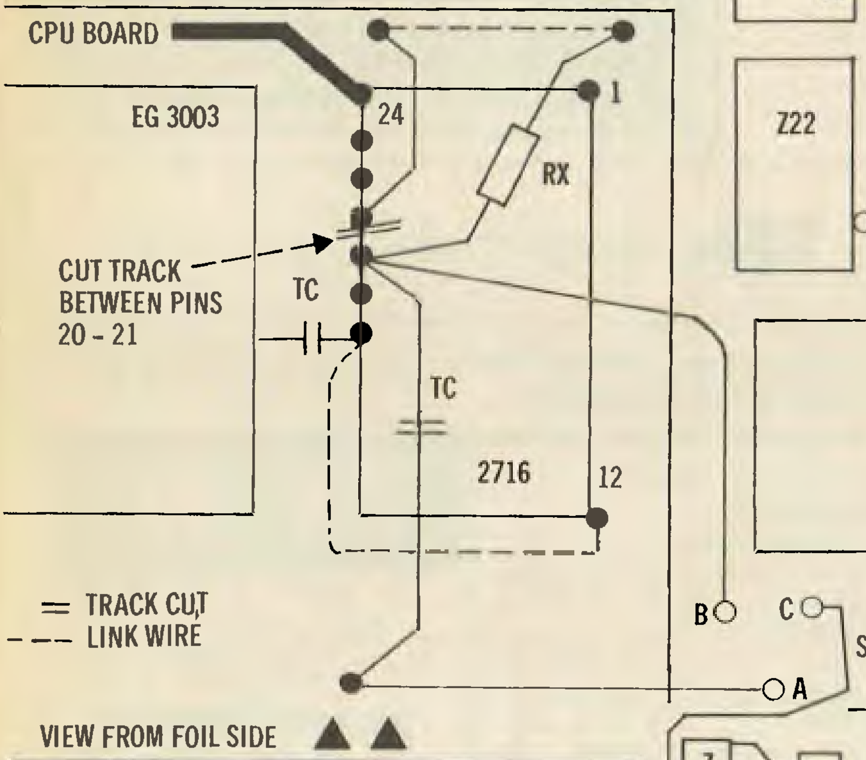
After eventually deciding to "take the lid off" my Video Genie EG 3003, I then did the standard "mods" of putting in an audio amp and changing the shift key for a clear and tab key. As I use Microsoft's Editor Assembler (Tape Version) I find the tab key essential when running this programme. The only way of saving an object code was on tape, this works fine but was quite laborious when loading a programme I have that prints data off the screen to my Teletype (110 boards).

"How nice it would be to have this programme in Eprom," I thought. Looking at the C.P.U. board there just happens to be an expansion area for a 24 pin device. This device is addressed at 3000-37FFH not used by my Video Genie at present except for a few addresses for a disc-based system.

Fitting a 24 pin chip base, a few track cuts, a resistor and toggle switch will allow 2K of Eprom at 3000h to be enabled when required.

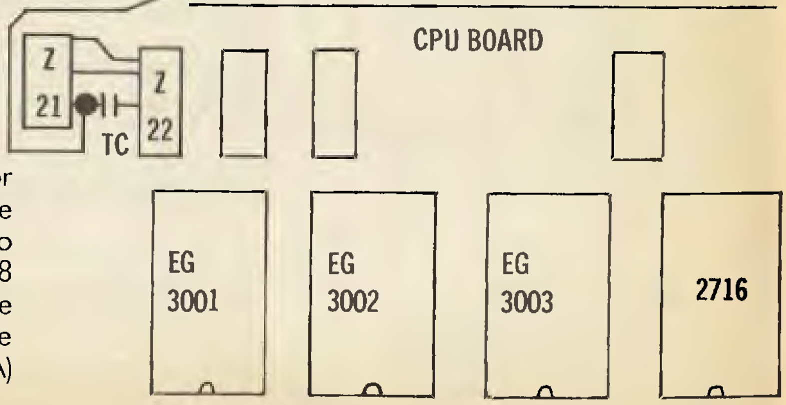
The only drawback with this system is that one has to be able to programme Eprom's. As I own a modified Softy, I can programme single rail Eprom's with ease. I think the Softy kit is well worth the expense of using machine code with the system I use on the Video Genie.





MOUNT S1 BY DRILLING HOLE IN THE FRONT LOWER HALF OF THE VIDEO GENIE CASE.
S1 IS A SPDT SWITCH
RX IS A 4K7 ¼ WATT

VIEW FROM COMPONENT SIDE



Using the Eprom

As I mentioned earlier, I have a utility programme for printing the contents off the screen. Lets suppose the programme started at 3000H, all you would have to do to run it is type "system hit newline, then type /12288 (3000H in decimal) hit newline. Don't forget to enable the device first by throwing the toggle switch to the enable position (B). The switch (SI) is best left in (A) position on switch on.

MEMORY AN INSIDE JOB

by Ian Sinclair

When I first bought my TRS-80, 16K seemed to be a very large amount of memory. At that time, 16K on the TRS-80 cost a lot less than 8 K on anything else, and it was then, and is even now, among the larger amount of free memory offered in a single box. For a lot of purposes, 16K was more than adequate, and coupled later with a Stringy-Floppy for mass storage, and a serial printer driven from the cassette port, 16K remained perfectly adequate for all my needs for a couple of years. Things only changed when I started to use the excellent Word Processing routine, the Electric Pencil, to a greater extent. Using 16K along with Electric Pencil leaves room for only about 2000 words of text, which is less than half the length of the average book chapter. There was, of course, no objection to recording the text (using cassette) in sections, but printing it was a nuisance, requiring the printer to be stopped at the right places so that a new load of text could be loaded in without spoiling the layout of a page.

Mysterious Reboots

At first, none of this tempted me to expand, because the "official" Tandy expansion involved buying another box which would cost as much as the computer did, and which had, like a well-known pill, some undesirable side effects, like losing your program when the RESET button was pressed. Friends who had expanded in this way also complained that they got mysterious reboots, returning to the switch-on procedure, along with loss of program. This was always attributed to the use of edge connectors which were solder-coated rather than gold-plated. My 16K machine was quite incredibly reliable, including the cassette operations, so that I resisted the temptation to expand.

This year, however, with five books in the form of cassette tape to print, and not so much time to spare, the possibility of expansion again loomed up. By this time, the expansion interfaces were no longer available, because the Model I had been out of production in the U.S.A. for a year. This wasn't such a great worry, because I had ordered a new BBC Microcomputer by that time anyway, but I still needed the TRS-80 to print out the material on cassette, as it might take me some time to devise a program to allow the BBC Micro to read and use Electric Pencil tapes. A series of adverts in the U.S. magazines, however, drew my attention to the possibility of internal expansion boards.

Internal expansion is an attractive proposition. It means using a board packed with 4116 RAM, plus one address decoding chip, sitting on the sockets of the original RAM. I knew that Video Genie owners had discovered that they could expand the Genie to 32K simply by "piggy-backing" RAM chips on top of the original ones, and the idea of using a better-engineered version appealed to me. Dynamic RAM like the 4116 does not take much operating power, and the unit was neat enough to fit inside the keyboard, eliminating the problems of these dodgy edge connectors. At 80 dollars for an expansion up to 48 K, I decided that it was a risk I had to try. This was in late July. I rang up the manufacturers, Holmes Engineering of Salt Lake City, Utah, and ordered the 48K unit.

By September, there was no trace of delivery, but another phone call brought me reassurance that the unit was on its ways. In November, with still no sign that anything was happening, I cancelled by letter, only to find a few days later that the unit was waiting for me in the local Post Office, together with a bill for £11.56 in Customs and V.A.T. There didn't seem much point in returning it by then!

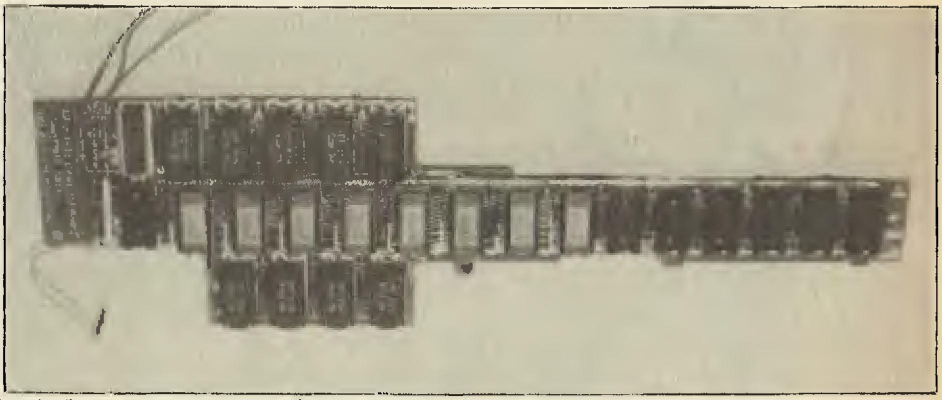


Fig 1 The memory board with 48K of memory on board

The unit is well constructed, and well thought out. Installation sounds easy, but requires some nerve and a certain amount of brute force. To start with, the TRS-80 keyboard has to be opened up. This invalidates the guarantee, but the guarantee is usually up by the time you take it out of the shop anyhow, and mine was well and truly up. My TRS-80 was purchased at a time when it was an almost unknown computer here, and it was a Compshop special, having started life as a 4K unit, and fitted with 16K over here. This meant that the seals were broken anyhow, and since I had earlier fitted the lower-case modification for the Electric Pencil, I felt that there wasn't much point in being queasy now.

Lumps of Solder

The installation of the additional RAM means removing the 8 4116 chips from the keyboard, and placing them in labelled positions in the new boards, along with another 32K (16 × 4116). I found some of the original 4116's mounted at crazy angles in their sockets, because of lumps of solder on the pins, which made me wonder where they had come from. I removed the solder, and plugged them into the new board. The instructions then call for four flying leads to be clipped to IC pins (one to a resistor) to give the decoding signals, and then the memory board, which is fitted with pins underneath, is plugged into the now-empty RAM sockets of the TRS-80.

Putting it back

Quite a lot of force is needed to push the pins of the memory board into the empty RAM sockets, and it isn't easy to support the main TRS-80 board so that this force can be exerted without damaging something. My first attempts were a disaster. The computer came on normally, indicating the presence of the full 48K of memory, but refused to run any programs. A memory test did not report any faulty memory, but dropped out with faults in non-existing lines, indicating that there was an address fault. Most programs simply landed back to the MEMORY SIZE? switch-on question when RUN.

Putting it all back as it had been did not cure matters, and a very close inspection of the main board revealed two possible causes. One was a capacitor lead which was perilously close to an address line, and might have been touching, the other was in the form of four sticky foam pads which were supplied with the board to help hold the clip leads in place. All of these pads were stuck across tracks on the board, and therefore a cause of potential trouble. Removing the pads and easing up the capacitor lead, a victim of the board insertion procedure, restored normal operation as far as I could tell.

I installed the board again, this time soldering the four flying leads in place instead of clipping them, and this time was rewarded with what looked like normal operation, despite problems caused by earlier modifications — the lower-case attachment wires had pulled some of the track off the board, causing problems with the video display. With this sorted out, a memory check program ran through all 48K with no faults reported, and no hang-ups. I began to feel that perhaps it had been worth while.

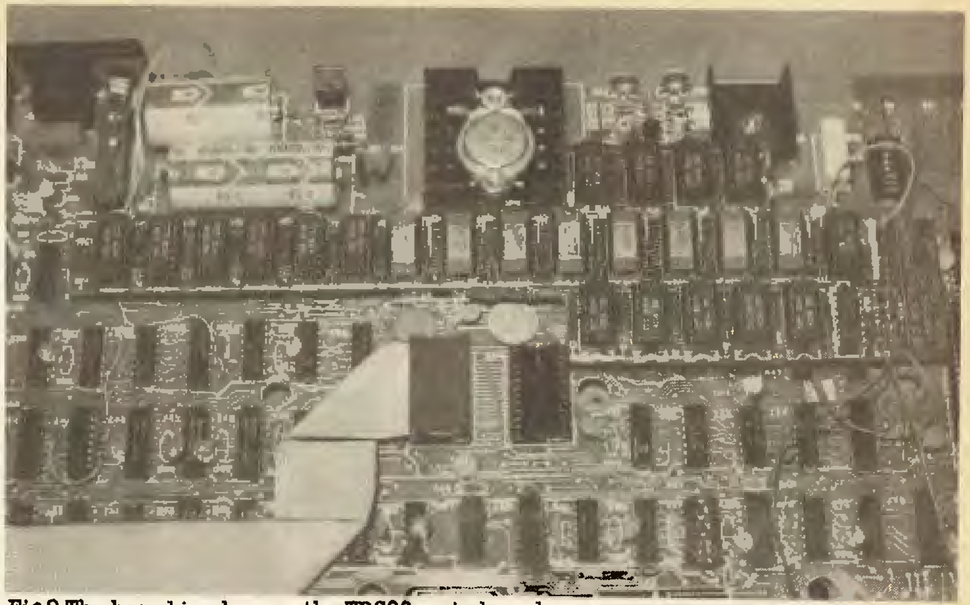


Fig 2 The board in place on the TRS80 main board.

My rejoicing was premature, however. The Electric Pencil soon found some new faults when I tried to use it. The program loaded perfectly, but then froze up when I tried to use it. and none of the keys had any action. After reloading and typing a thousand words, I lost the lot when it abruptly returned to its MEMORY SIZE? switch-on procedure. It looked as if I had exchanged a reliable 16K unit for a very unreliable 48K one.

I started trying remedies. The first thought was that that the power supply was overloaded. The test was to take 32K of memory out, and try again. Same problem — totally unreliable. Next obvious step was to take the memory board out and try again. This seemed to stop the problems, and I got a mornings work done, then sent the memory board back.

Unfortunately, my troubles were not over. The TRS-80 became more and more unreliable, and every attempt I made to cure it made it worse. I ended up selling it for scrap.

So there it is. A memory of 48K for only £50 or so looks very attractive, but you have to be prepared for problems. Lets face it, if someone like me who has lived with the smell of hot solder for 30 years can be caught out, then you too might just wreck a good computer as well. In particular, you must be prepared to handle the fragile TRS-80 board with very great care, and to inspect everything after installing the board. While I was waiting for delivery of the expansion board from the U.S., several firms in the U.K. started to advertise dynamic RAM expansion boards, and if I had not already had the board on order, I would have been very tempted to use a locally-made product. If you have problems, its always more comforting to know that the manufacturer is only a few hundred miles away rather than a few thousand.

Traumatic experience

Scrapping a computer has been a traumatic experience, and it has convinced me that a computer design which is arranged to make expansion easy, with the minimum of handling of the boards, will always be a better buy than one which needs modification. This approach is reflected in all the newer designs, like the TRS-80 Model III, and the BBC Microcomputer. It is also the reason why so many educational authorities have plumped for the RML 380-Z — its ability to expand by simply plugging in more boards makes up for the high initial price, and the price of the RML-380Z with 48K and twin double-sided discs compares very famourably with the price of the Model III TRS-80. Another point in favour of the 380Z is that all connections from the main computer are made through robust Cannon-type plugs and sockets, rather than through fragile edge connectors with unreliable contacts.

As a tailpiece, I have just seen the U.S. expansion board for the TRS-80 advertised from some dealers in the U.K., at only twice the price I paid. Perhaps at that price, they can fit the board and guarantee their workmanship for a year. I, for one, won't look at "add-ons" unless I can have that sort of guarantee that I will have a reliable computer afterwards.

COMPUTER AIDED DESIGN

by Ralph Lovelock

This is the first part in a nine part series on computer-aided-design.
We hope that during the next few months readers who follow the series will become well equipped to design their own electronic circuits using a personal computer. The computer used by the author for the series is the ZX81 with the 16K memory extension. The whole series should comprise of the following parts subject to changes later:

1. *Introduction of CAD.*
2. *Assembly by matrices.*
3. *From two terminal impedances to two part matrices. (Algorithms).*
4. *Balanced bridged, and twin tee filters. (Algorithms).*
5. *Transformers and Lines. (Algorithms).*
6. *Overall logic of control program. (Including the program itself).*
7. *Inputting the individual component values. (Including sub-routine program).*
8. *Outputting overall results and de-bugging tests. (Including programs).*
9. *Operating instructions, Interpretation of results, etc.*

There will be some complex arithmetic in part 3, equivalent circuits and matrix type conversions in part 4 and some transmission problems in part 5.
Details of mathematical derivations will be included separately for those readers whose maths does not stop at 6th form, but detailed mathematical discussions are avoided in the text.
While this is the most ambitious project we hve undertaken for the ZX81 it should provide this low cost machine with a new type of status and it will rapidly be regarded as a quite serious design tool.
While some of the maths is quite heavy later in the series we feel it would not be right to water this important feature down and indeed talk down to readers – best of luck – Ed.

It is hoped that this article may be the first of a series dealing with the present continuing development of an ambitious CAD suite of programs on a ZX81 with 16K and printer. In the future it is hoped to develop (or obtain from Sinclair if they make it available) a second 16K extension to increase the scope of the present project; the addressing is already available within the machine, and the type of extension connector used to add the printer should serve also to add a further memory bank, but, of course a second power unit will be necessary to drive it.

The reader is warned that the series of programs to be described are written for the ZX81; the Basic of this machine has a number of features non-standard on any other, but the coding of the Basic and of the keyboard make it much faster to key long programs, and the editing facilities are excellent and make development and de-bugging easy.

With a long program such as the final suite under development, it is impossible to key and debug the whole thing, even if a day exceeding 14 hours could be worked with mind still alert, a 'glitch' on the mains, lasting only a few milli-seconds, suffices to remove several hours of work from the RAM. Sections of the program are keyed, and when more than a hundred lines are in, the whole is run onto tape. At a later time, it can be put back in a few minutes, edited to remove problems, a further section added, and the whole then recorded again. During development, a single C12 cassette has been used, recording first on one side, and then on the other, switching backwards and forwards so that if for any reason (no single instance has yet arisen), the new recording proves faulty and fails to load, only the most recent additions are lost, and the original is still available on the other track.

The present project is written in sections, each one terminated in a 'RETURN' so that only those necessary need be used, economising in memory and easing considerably the problems of development and de-bugging. Given a design of circuit and values, it is simple on a computer to evaluate the exact performance, but it is virtually impossible to start from a desired characteristic and calculate the exact values of practicable components to produce it. Most existing designs can only be calculated from scratch for 'ideal' components with zero dissipation, and the existant 'strays' and losses give a considerable departure from the theoretical values in the neighbourhood of the many resonances usually involved.

It is only the immense amount of work which can be accomplished in a small time that enables an alternative method to be used in these cases, when a computer is employed. The method involves 'iteration', the zero-dissipation designs already published are used to feed initial values, along with practical values of dissipation, into the machine, and record on a printer the exact characteristic resulting; the program is so written that without disturbing the main values, a small change may be made where experience shows an improvement may be expected, and the resulting characteristic run again. This method of slowly adjusting one value at a time and noting the results, will eventually lead to a set of optimum values and a reliable forecast of performance.

For anyone not familiar with the method, the following short and useless program can be run and the efficacy of the method noted step-by-step. It is a very inefficient method of calculating a square-root, and is only presented to give a visual example of the principal of iteration.

```
10. PRINT "input X / 1"
20. INPUT X
30. LET W = X/2
40. LET Y = W**2
50. PRINT W; "= SQR"; Y, X
60. STOP
70. LET W = W + (X-Y)/2
80. GOTO 40
```

Initiation by keying 'RUN 10' will give an invitation to input a value greater than unity, and then wait for the value to be entered. Entering it, and keying NEWLINE will give a first estimate of the square root of the number keyed, together with the square of the estimate and the number keyed. Keying CONT and pressing NEWLINE will then give an improved estimate. Continuing keying will give a steadily closer approach which alternates from side to side of the exact value. The process may be continued until the difference displayed on the screen is as close as may be desired.

This first article is being written so that the editor may decide whether he is interested in continuing the series, so that instead of spending space on discussion of the method adopted to evaluate complicated circuit performance, and which may not come to publication, a useful section of the suite will be given, employing no very original methods, but being a series of short sub-routines, which may prove useful in ▶

any attempt to calculate circuit performance, since all such will employ complex arithmetic which is performed by this program.

Most elementary manuals recommend using the REM statement prolifically to enable the logic of the program to be followed readily, but this entails a very wasteful use of expensive memory; the form presented here dispenses with this luxury, and annotates the printed version of the programme, which is the place where one looks for enlightenment, and where the explanations can be phrased in a wider symbology than is available on the normal home computer. There is nothing original in this program, but a few points are worth noting for the help of those new to programming.

The values of the 'complex' expressions are contained in two arrays, A for the real component and B for the imaginary one. For ease of menomonics when writing programs which utilise these routines, the entry indices are constant as C for the first expression, and D for the second; E is invariably used for the one output. This principle is altered in 1470, 1500 & 1520 to allow a free transfer between them when obtaining the square root; this economises in memory space in the calling program.

While the general case is easily covered, there may be times when either an error in computation, or else unique combinations of values, will cause the computor to 'go mad', and these must have a guard to prevent it happening. Line 1280 contains a typical example; the variable I occurs as a divisor, and should the machine be presented with a zero value, it is advisable to draw immediate attention to the fact and enable the locality to be examined. Another example occurs in line 1471 where for a quantity purely imaginary, the normal ratio used for calculating the angle would lead to division by zero, and give a result equal to infinity which is the true value of the tangent, the computer is not equipped to deal with this, and the way around the problem used there must be adopted.

Another feature of the Basic can also set a trap for the unwary. The square of a negative number is always positive, but the computer, in common with most pocket calculators cannot deal with this situation, and the function ABS must be used for quantities squared as is done for example in line 1280.

The only case in this suite of routines where the algebraic values are not used throughout occurs in 1250. Here a multidimensional array M is used. In future programs to be covered this array will be used more frequently than any other, but it is only introduced in this one case because in a very frequently called use the inclusion

Continued on Page 50

LADNET

`1235 LET A(E) = A(C)*A(D)-B(C)*B(D)`	$(a+jb)(c+jd)=$
`1236 LET B(E) = A(C)*B(D)+A(D)*B(C)`	$(ac-bd)+j(bc+ad)$
`1240 RETURN`	
`1250 LET A(E) = M(3,A,B,1)*M(1,C,D,1) - M(3,A,B,2)*M(1,C,D,2)`	Product as above but using matrix elements with algebraic output
`1255 LET B(E) = M(3,A,B,1)*M(1,C,D,2)+ M(3,A,B,2)*M(1,C,D,1)`	
`1260 RETURN`	
`1280 LET I = ABS A(D)**2 + ABS B(D)**2`	$\frac{a+jb}{c+jd}=$
`1281 IF I = 0 THEN GOTO 1290`	$\frac{ac+bd}{c^2+d^2}+j\frac{bc-ad}{c^2+d^2}$
`1285 LET A(E) = (A(C)*A(D) + B(C)*B(D))/I`	
`1286 LET B(E) = (A(D)*B(C) - A(C)*B(D))/I`	
`1287 RETURN`	
`1290 PRINT ES`	Error in Data
`1291 STOP`	If Cont if Keyed
`1295 RETURN`	Program continues
`1360 LET I = ABS A(C)**2 + ABS B(C)**2`	$\frac{I}{a+jb}=$
`1361 IF I = 0 THEN GOTO 1370`	$\frac{a}{a^2+b^2}-j\frac{b}{a^2+b^2}$
`1365 LET A(E) = A(C)/I`	
`1366 LET B(E) = - B(C)/I`	
`1367 RETURN`	
`1370 PRINT ES`	Error in Data
`1371 STOP`	If Cont is Keyed
`1375 RETURN`	Program Continues
`1450 LET A(E) = ABS A(C) B(C)**2 - ABS B(C)**2`	$(a+jb)^2=$
`1451 LET B(E) = 2*A(C)*B(C)`	$(a^2-b^2)+j(2ab)$
`1460 RETURN`	
`1470 LET R(D) = SQR(ABS A(C)**2 + ABS B(C)**2)`	$R=\sqrt{a^2+b^2}$
`1471 IF A(C) = 0 THEN GOTO 1475`	$\theta=\mathrm{TAN}^{-1}\frac{b}{a}$
`1472 LET T(D) = ATN(B(C)/A(C))`	
`1473 RETURN`	
`1475 LET T(D) = SGN(B(C))*PI/2`	
`1480 RETURN`	
`1500 LET A(E) = R(C)*COS T(C)`	$R\,\mathrm{COS}\theta+j\mathrm{SIN}\theta=$
`1505 LET B(E) = R(C)*SIN T(C)`	$a+jb$
`1510 RETURN`	
`1520 GOSUB 1476`	$\sqrt{a+jb}=$
`1525 LET R(C) = SQR R(D)`	$\sqrt{R}$ AND $\frac{\theta}{2}=$
`1526 LET T(C) = T(D)/2`	$c+jd$
`1530 GOSUB 1500`	
`1540 RETURN`	

ARRAYS

A_x = REAL COMPONENT

B_x = IMAGINARY COMPONENT

R_x = RADIUS T_x = ANGLE

$M_{x_1\,x_2\,x_3\,x_4}$ = MATRIX ELEMENT

x_1 = MATRIX NUMBER, x_2 = ROW, x_3 = COLUMN, x_4 = REAL & IMAG.

STRINGS

ES = "ERROR"

SALE ELECTRONIC GAMES

ATARI T.V. GAME

THE GAME WITH 60 CARTRIDGES

R.R.P. £129.95 (inc. VAT)

OUR PRICE £78.22 + VAT

(= £89.95 inc. VAT)

The Atari is supplied with a free mains adaptor, a pair of paddles, a pair of joysticks and a combat cartridge and is the most popular television game on the market and has a range of over 40 different cartridges. In addition to the standard Atari range we also now stock the new Activision cartridges which are currently on special offer reduced from £18.95 to **£16.95 inc. VAT**

ATARI CARTRIDGES

20% OFF R.R.P.

Atari Soccer £29.95
NOW £23.95

Activision Dragster £18.95
NOW £14.95

Activision Boxing £18.95
NOW £14.95

ATARI OWNERS CLUB — Why not join our *FREE* Silica Atari Owners Club and receive our bi-monthly newsletter with special offers and details of the latest new cartridge releases. Telephone us with your name and address and we will add your name to our computer mailing list.

MATTEL INTELLIVISION

THE ULTIMATE T.V. GAME

R.R.P. £229.95 (inc. VAT)

OUR PRICE £156.48 + VAT

(£179.95 inc. VAT)

6 NEW CARTRIDGES JUST RELEASED:
ASTROSMASH ★ SNAFU ★ BOWLING SPACE ARMADA ★ BOXING TRIPLE ACTION

All 19 current cartridges + the six new ones above now retail at £19.95 — Silica special offer price **£17.95 inc VAT**

The Mattel Intellivision is the most advanced T.V. game in the world with a range of over 25 different cartridges all at our special offer price of £17.95. This game uses a 16-bit microprocessor giving 16 colours and three-part harmony sound. The picture quality is incredible with 3D effects and realistic animation. An add on keyboard will be available in the Spring 1982 to convert the Mattel into a full home computer with 16K RAM which will be fully expandable and programmable in Microsoft Basic. Other accessories will be added later in the year. The normal price of the Intellivision + free soccer cartridge is £229.95 but our special offer price is £179.95 inc. VAT saving you £50.00.

MATTEL OWNERS CLUB — Why not join our Mattel Owners Club and recive our regular newsletters containing details of all the latest cartridge releases. Telephone us with your name and addresses and we will add your name to our computer mailing list.

FREE 16 PAGE CARTRIDGE CATALOGUE — If you are interested in owning a Mattel, we now have available a 16 page catalogue describing the latest six cartridges to be released, as well as a new Mattel colour leaflet with brief descriptions of all 25 cartridges. Telephone us for further details.

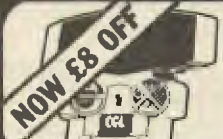
T.V. GAME CARTRIDGES

We specialise in the whole range of T.V. games and sell cartridges for the following games:
ATARI ★ MATTEL ★ ACETRONIC ★ PHILIPS ★ DATABASE ★ ROWTRON ★ INTERTON ★ TELENG

Let us know if you own any of these games and we will let you have details of the range of cartridges available.

Attention INTERTON & ACETRONIC owners we have over 75 assorted used cartridges in stock all with 1 year guarantee — *SPECIAL OFFER* £8.95 each

We also have a number of secondhand games and cartridges.

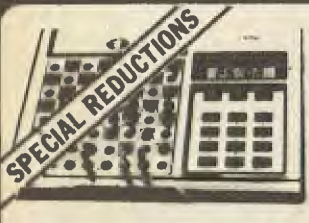


HAND-HELD GAMES

EARTH INVADERS

These invaders are a breed of creature hitherto unknown to man. They cannot be killed by traditional methods — they must be buried. The battle is conducted in a maze where squads of aliens chase home troops. The only way of eliminating them is by digging holes and burying them.

R.R.P. £26.95 **NOW £18.95** inc. VAT



ELECTRONIC CHESS

Liquid crystal battery chess computer with 100-200 hrs battery life and two levels of play. Comes with separate chess board and pieces.

NOW £5 OFF
R.R.P. £24.95
SALE PRICE £19.95 (inc. VAT)

GRADUATE CHESS

A de luxe version of the electronic chess set with integral chess board. The ideal portable chess set — see illustration.

NOW £29.95 INC VAT

FIDELITY MINI-SENSORY CHESS COMPUTER

The very first chess computer of its price to offer a portable computer with integral sensory board. Battery (6-8 hrs) or mains operated. This is a modular game and additional plug-in modules are planned for 1982 for advanced chess, popular openings, greatest master games, draughts and reversi.

MINI-SENSORY COMPUTER WITH STANDARD CHESS MODULE WAS £54.50 *NOW* **£49.95** INC VAT

Silica Shop are one of the country's leading specialists in Chess Computers and now stock a range of more than 20 Chess Computers, including Challenger 7/10/voice, Sensory 8 and Sensory Voice, Diplomat, System 3, Morphy, Great Game Machine, Voice Champion, and the new Scisys Mark V.

PAC MAN 2

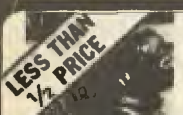
Pac Man 2 is based on the latest pub game. It is a two-colour game of strategy, tactical pursuit and destruction pitting Pac Man against the large Ghosts. The object of the game is for Pac Man to attain as high a score as possible by capturing and destroying Ghosts. Bugs and Energizers without being himself destroyed by the Ghosts. Pac Man 2 incorporates the most modern and complex status displays ever produced and is now on release for the first in the UK offering an ideal present.

R.R.P. £34.95 **NOW £24.95** inc. VAT

SPACE INVADERS

Based on one of the most popular arcade games, Space Invader™ packs in lots of action with multi-shaped, brilliant LED vessels, including attack ships, bombs, defenders, missile rockets and a beam force cannon, plus exciting electronic sound effects. The attack ships attempt to bomb the ground defenders as they are moving. You manoeuvre the missile rockets — avoiding alien bombs — and destroy the invader force as quickly as you can. Progressive degree of difficulty. Includes automatic digital scoring. For ages 6 to adult.

R.R.P. £24.95 **NOW £16.95** inc. VAT



COLOUR CARTRIDGE T.V. GAME

Semi Programmable T.V. game
+ 4 cartridges
+ mains transformer
NOW £43.50 OFF
R.R.P. £73

SALE PRICE £29.50 inc. VAT

BACKGAMMON COMPUTER

Silica stock a wide range of Backgammon computers from £28.95 upwards. Special offers now available on Gammonmaster

Was £99.95

NOW **£48.95** inc VAT

CALL JOTTER — THE AFFORDABLE ANSWER

The Post Office certified telephone answering machine

"Sorry darling, I will be late home — Love John"

The Call Jotter I brings the affordable answer at the amazing price of £69 (or £99 for the Call Jotter 2 with built-in remote recall facilities). These amazing telephone answering machines are Post Office certified and guaranteed for one year. They make a thoughtful gift for home or business use.

Call Jotter 3 illustrated *NOW* **£69.00** inc VAT

TWINTAPE £139

RADOFIN TELETEXT

Plug the adaptor into the aerial socket of your colour TV and receive the CEEFAX and ORACLE television information services

THIS NEW MODEL INCORPORATES:
*Double height character facility *True PAL Colour *Meets latest BBC & IBA broadcast specifications *Push button channel change *Unnecessary to remove the unit to watch normal TV programmes *Gold plated circuit board for reliability

ADD-ON ADAPTOR

WAS £199 inc. VAT

SALE PRICE £124 inc VAT

FOR FREE 301 1111

For free illustrated brochure and reviews on our range of electronic games, please [illegible] on 01-301 1111. Free delivery service available. To order by telephone please quote your name, address and ACCESS/BARCLAYCARD number, and leave the rest to us. Post and packing Free at Charge. Express 48-hour delivery service available.

- CALLERS WELCOME — Demonstrations daily at our Sidcup shop open from 9am-6pm Monday-Saturday (Early Closing Thursday 1pm — Late Opening Friday 8pm)
- 2 YEAR GUARANTEE — All goods are covered by a full year's guarantee and many are further covered by our exclusive Silica Shop 2 year Guarantee
- MONEY BACK UNDERTAKING — If you are unsatisfied with your purchase and return it within 7 days we will give you a full refund
- AFTER SALES SERVICE — Available on all machines out of guarantee
- COMPETITIVE PRICES — We are never knowingly undersold
- HELPFUL ADVICE — Available on the suitability of each machine
- **CREDIT FACILITIES — Full credit facilities available over 12, 24 or 36 months at competitive rates of interest**
- PART EXCHANGE SCHEME — available on second hand machines
- CREDIT CARDS WELCOME — Access, Barclaycard, Diners Club, American Express

SILICA SHOP LIMITED Dept ECM0382
1-4 The Mews, Hatherley Road, Sidcup, Kent DA14 4DX
Telephone: 01-301 1111 or 01-309 1111

SILICA SHOP

MICRO-COMPUTER UPDATE

Our tables this month give a comprehensive update on what's available on the micro scene.

Note in particular the British-made offerings; these have increased substantially over the past 6 months with prices somewhat cheaper than the imported models for very comparable specification.

Perhaps we as a nation are not going to get wiped out of the micro-computer market quite so easily as some of the prophets of gloom would have us believe.

Prices however should be treated with some caution since certain essential pieces of software, such as the operating system, are often charged for extra. The Vector Graphic for instance comes with approximately £700 of software as standard, the Xerox 820, non.

The Japanese are now very much in evidence with Sharp in particular about to overtake Apple for third position in the U.K. Certainly the Americans must be very worried especially at the middle range price band of £500 — £1,500.

One nice feature arising as a result of the British and Japanese presure on the American top dogs is that British comprehensive guarantees of 1 year, rather than the American 90 day limited warranty is becoming standard.
The Japanese competition in particular should also result in much more standard software being offered with each system rather than charging extra for it as at present.

In addition to the information contained in the tables below there are other considerations you should take into account before deciding on a particular computer.

Obviously the points to note, will differ in priority beween a business or scientific application and a home application. We have therefore listed them separately as follows:-

HOME USE

Is the system big enough for your present needs and will you be able to expand it to meet future plans? In particular look for the ability to expand memory and the availability of standard ports (RS232C or Centronics).

What period is the warranty? 1 year is now standard.

The magazines are full of interesting software programs sent in by readers. Can their Basic programs be easily adapted to run on your machine? Most dialects of Basic are easy to convert. But Tiny Basic is not usually downward compatible from Extended Basic. Others such as Acorn Basic can prove difficult.

What standard off the shelf programs exist? Games, Teaching, WP etc.

Is the system complete? Or do you have to buy connecting leads, power supplies, magnetic storage devices, output interfaces etc at extra cost.

If so how much do they come to? An RS232C interface can cost £70 for example.

Does the supplier offer a 'Help' service. Essential for a first time user. If you are contemplating a kit this should be your priority question.

Will it be possible to use a colour monitor.

THE PROFESSIONAL USER

How long has the supplier been in the business?

Is there a reference site where you can see your particular application being used.

What are the future expansion capabilities? With particular reference to disc storage, multi-user, plug-in board enhancements.

Is the system CP/M based? You may be dependent upon one supplier for your software if it is not.

Is the internal architecture based on the S-100 standard or some other common standard such as IEEE-448 or SS50? This is particularly important if it is envisaged that A-D converters, Signal processors, added memory boards, clocks etc could be needed in the future.

How many external ports, RS-232C or Centronics do you get with the system, and can you have extra at a later date? You may wish to add an extra disc drive, modems or graphics plotter to your system, or run two printers a fast dot matrix and a letter quality daisy wheel.

Is the system capable of being expanded to multi-user operation? Many now are, but insist on a demonstration with at least three terminals, as some slow down by a significant amount.

If multi-user operation is a consideration the following question should be asked.

★ Is multi tasking possible?
★ Does the OS provide record and/or file locking?
★ What about file security? Coding etc.
★ What is the maximum number of terminals?
★ How far can they be spaced apart?
★ Is the slow down in processing speed still acceptable with the max number of terminals.

Where is the system manufactured?

What is the guarantee period? Many are still only 90 days.

Is there a 24 hour on-site maintenance contract available for your area?

How much does it cost? Betwen 10 and 12% of system cost is typical.

Does the supplier have a software support team available to back up your application? This is an important consideration for most business users.

What kind of printers can I have? You will want daisy wheel for word processing applications and dot matrix for draft and label printing.

British Built Micro-computers

Company Name	Mod. No.	PRICE exVAT #	RAM size K	CPU type	VDU ?	tape ?	MAGNETIC STORAGE DOS	Floppy	Main Mkt.
Acorn	Atom	152	2	Z80	no	no			Home
BBCmicro	BBC	235	16	6502	no	no			Home
BMG	MS5001		64	8085	yes		CP/M	2x8	Bus.
Brit/"	Mimi801	1,350	64	Z80	yes		CP/M	2x5	Bus.
Brittania			64	6800	yes			2x5	
Cifer		2,357	64	2xZ80	yes		CP/M	1x5	Bus/Ed
Comart	CP-100	2,200	64	Z80	yes		CP/M	2x5	Sci/Ed
Compukit	UK101	228	4	6502	no	no			Home
Haywood	3000	1,925	64	Z80	yes		CP/M	2x5	Bus.
Clencoe	Conqrer	2,475	64	Z80	yes		CP/M	2x8	Sci/Ed
IDS Ltd	Oscar	2,495	64	Z80	yes		CP/M	2x5"	Bus.
ICL	Sys20	2,500	64		yes		own	2x5	Bus.
Io-Tech.	Iona	2,900	64	Z80	yes		CP/M		Bus/Ed
LSI	M-3	2,400	64	Z80	yes		CP/M	2x8	Bus.
MicroSol	BritGeni	2,300	64	Z80	yes		CP/M	2x5	Bus.
MicrValu	MV-3	1,550	64	Z80	yes		CP/M		Bus/Ed
Millbank	Sys10	2,995	64	Z80	yes		CP/M	2x5	Bus.
Positron	9000	1,540	64	6809	yes		OS-9		Ed/Sci
Quantum	2000	2,250	64	2xZ80	yes		CP/M	3x5	Sci/Ed
Rair	BlckBox	2,500	64	8085	yes		CP/M	2X5	Bus/Sci
Res/Mach	380Z	3,500	56	Z80	yes		CP/M	2X8	Ed
Rade	1000	1,480	64	Z80	yes		CP/M	2x5	Bus.
Shelton	Sig/net	1,299	64	Z80	yes		CP/M	2x5	Bus.
Sinclair	ZX-81	61	1	Z80	no	no			Home
Tangrine	Micron	343	8	6502	no	no			Home
Transam	Tuscan	1,449	64	Z80	yes		CP/M	2x5	Bus/Sci

Low Cost Imported Models.

Origin						Does the Price include		
	Name	Mod. No.	PRICE inc.VAT (pounds)	RAM size (000)	CPU type	VDU ?	colour display	tape ?
USA	Apple	II	695	16	6502	no	yes	no
FE	Atari	400	345	16	6502	no	yes	no
FE	Atari	800	645	16	6502	no	yes	no
HK	APF	IM-1	400	8	6502	no	yes	yes
FE	Commdr	VIC20	200	8	6502	no	yes	no
Belg	DataApp.	Dai	684	48	8080	no	yes	no
USA	Exidy	Sorcrer	458	16	Z80	no	no	no
HK	Genie	EG3000	330	16	Z80	no	extra	yes
USA	Pet	I	529	16	6502	yes	no	no
Hol	Pearcom	PearII	975	32	6502	yes	yes	no
Jap	Sharp	MZ80K	454	20	Z80	yes	no	yes
Jap	Sharp	MZ80B	1259	64	Z80	yes	yes	yes
USA	Tandy	TRS80-I	400	4	Z80	yes	no	yes
USA	Tandy	" III	573	4	Z80	yes	no	yes
USA	Texas In	99/4	282	16	9900	no	yes	no

Can I inspect the manuals? Sloppy documentation, sloppy outfit.

What about staff training?

What other applications packages are available which could be used in my company? e.g. WP, DBMS, Financial modelling etc.

What is the capacity of the disc storage system you are being offered? Make sure it is more than sufficient for your present requirement.

Is it a dual or single drive? For most business applications a dual drive is the minimum recommended.

Is a hard disc option available? This is fast becoming the most economical way to add large amounts of memory.

What is the size of the main core memory? 64K is now the norm.

What is the user area available? The operating system always takes up some space and the more sophisticated the OS the more room it requires.

What program languages will the system support? COBOL for business software; FORTRAN for scientific; APL, PASCAL, and of course BASIC for anything.

Will I need to learn programming? Its great fun to learn anyway.

What about modifications to a program? Can this be done by the supplier?

Is there a RENTAL or LEASING scheme available, and what does it cost?

Is the computer noisy? The fan on some certainly is.

Wht is the colour of the screen? Are the characters too small? Will it be a strain on the operators eyes? Some are. And some trade unions have introduced standards.

How quickly does the representative respond to your questions before the sale? If he's slow now he certainly won't speed up after you have purchased.

More Update Tables on Page 59

data-cassette

ALL PRODUCTS FULLY GUARANTEED

TRADE ENQUIRIES WELCOME

EVERYTHING YOU NEED FOR CASSETTE BASED SYSTEMS

COMPUTER CASSETTES

High quality 5 screw assembled cassettes supplied with library boxes. ANY LENGTHS AVAILABLE

C10 — 32p   C20 — 36p
C12 — 33p   C25 — 38p
C15 — 34p   C30 — 39p

E704

SAVE 5p ON EACH CASSETTE WHEN ORDERED WITH **STACK-PACK** INSTEAD OF LIBRARY CASES. (MIN. 1 DRAWER OR 2 CASSETTES).

STACK PACK

A unique system of interlocking twin drawers for cassette storage. Add on extra drawers as your library expands. Save on library boxes, index cards and space!

60p per drawer
£2.50 for five   E695

CONNECTING LEADS

E101   3 PIN TO 3 PIN   £1.80

The lead to connect the 5 star cassette recorder to your personal computer.

All types of lead and plugs available — please enquire stating specifications.

STOP PRESS

NOW AVAILABLE!! Programming and analytical support for your micro-computer (Basic or Cobol). London and Home Counties only.

CASSETTE RECORDERS

12 MONTH GUARANTEE   **£17.00**

E302 5 STAR CASSETTE RECORDER

Ideal for recording and loading your programs. It features:

- ▲ DIN SOCKET
- ▲ TAPE COUNTER
- ▲ TONE CONTROL
- ▲ BUILT IN MIC
- ▲ AUTOSTOP
- ▲ **MAINS/BATTERY**
- ▲ AUTO RECORD LEVEL
- ▲ EARPHONE
- ▲ FREE HEADCLEANER

PLEASE ENQUIRE ABOUT OTHER RECORDERS

CASSETTE WORKSHOP

E801   FIXOTAPE

SAVE THAT PROGRAM!

Semi-automatic, helps untangle edit and repair damaged cassettes.

£1.99

E613	Screwed case empty cassettes including leader	25p each
E611	Empty library cases	36p for 4
E615	Head cleaner cassette	49p each
E614	Cassette joining tape	45p per reel
E612	Cassette index cards	27p for 12

ORDER FORM

CODE	QTY	DESCRIPTION	PRICE EACH	TOTAL
			CARRIAGE 5% (MIN £1.00)	
			TOTAL DUE	

All prices inclusive of V.A.T.

TELEPHONE ORDERS WELCOME

Mr/Mrs/Miss (CAPS) ....

Del. Address ....

.... Postcode ....

Access/Visa No.

Signature ....

Please make cheques payable to: STORKROSE LTD., 44 Shroton Street, London NW1 6UG. Tel: 01-723 0141.

EC4

Readers' Letters

ECM welcomes correspondence from readers. Please keep letters constructive and mark 'private' if not for publication. Address them to: Readers Letters, Electronics & Computing Monthly, 67 High Street, Daventry, Northants., NN11 4BQ.

Simple Modification

16th December, 1981

Dear Editor,

I enclose a copy of a letter I have sent to one of your correspondents.

Perhaps this letter, suitably modified, could serve as a letter to yourself for publication.

A simple modification would be to change four "your's" to "the". They occur in the first line (2 of them), in the last line of the penultimate paragraph ("your results"), and in the first line of the last paragraph ("your program").

Yours sincerely,
W. E. Thomson
Woodhaven
Leiston Road
Aldeburgh, Suffolk IP15 5PX

Number Puzzle

16th December, 1981

Dear Sir,

The answer to the query in a letter to Electronics & Computing (Jan 1982 issue) is that the function SQR, which relies on a series of successive approximations carried out in finite-precision floating-point binary arithmetic, cannot always get things exactly right.

The following ZX81 program allows the input of an expression and the printing, not only of its value in the usual decimal form, but also of the decimal values of the five bytes of its internal floating-point binary representation (see ZX81 programming manual, p 193, first four paragraphs).

```
10 LET A=0
20 INPUT E$
30 LET A = VAL E$
40 PRINT E$;"=";A
50 FOR I=0 TO 4
60 PRINT TAB 4*I; PEEK (PEEK 16400 +
   PEEK 16401 + I + 1);
70 NEXT I
80 PRINT
90 GOTO 20
```

Using this to investigate SQR 25 leads to:

```
SQR 25 = 5
131 32 0 0 1
INT SQR 25 = 5
131 32 0 0 0
```

So, for the ZX81, SQR 25 does *not* equal INT SQR 25, hence the results.

There are various ways of amending the program; perhaps the simplest is:

IF INT SQR A * INT SQR A = A THEN . . .

(Don't be tempted to shorten this to INT SQR A ** 2 = A. This doesn't work either).

Yours sincerely,
W. E. Thomson
Aldeburgh, Suffolk

Physical Morality

Dear Sir,

An interest in computing has lead me to speculate upon the possibility of physical immortality for the individual. This idea is expanded in my article "Immortalism and Personal Computing" (Electronics and Computing Monthly (date)).

I have been in contact with various various American organisations and have amassed considerable data on this subject, which I would be willing to share with anyone writing to me. I am also willing to discuss by correspondence points raised in the article. I am also in correspondence with a small group who meets informally in London to discuss this subject, and can put those interested in touch.

Sincerely,
J. de Rivaz BSc(Eng)
West Towan House
Porthtowan
Truro, Cornwall TR4 8AX

Golf Game Program for Sinclair ZX81

18th December, 1981

Dear Sir,

I consider that the above program published in the December Issue of your magazine was very stimulating and interesting and certainly a refreshing change from the glut of variations of Space Invaders and most other Video games.

However I did find some errors in the listing when programming, which I note for your attention.

Amended lines:

```
15 FOR I = 0 TO (Y1—L)*YI*F/L
520 LET DFILE = PEEK 16396+256*PEEK
16397+I
1070 PRINT TAB I; "□" (graphics shift H)
1680 PRINT AT 21,0; "OUT OF BOUNDS
— PENALTY SHOT"
1685 GOSUB 5010
1690 PRINT AT 0,22; SHOTS
```

Yours faithfully,
M. P. Wood
68 Bridgewater Road
Ipswich, Suffolk

Strange Results

Dear Sir,

With regard to Mr. Dowling's "Number Game" (Jan 1982), a couple of errors seem to have crept in.

Line 80 should read IF SQR A = INT SQR A . . . and line 90 has a quotation mark missing and will probably work better if inserted between lines 120 and 130.

On the other point about the ZX producing strange results with squares of number, I had not noticed this before, but by using PRINT SQR X — INT SQR X (where X is the faulty number) a curiously regular discrepancy of either 1.8626452 E-9 or 3.7252903 E-9 is found With the accuracy normally produced, in mind, this seems an unusual oversight on the part of Sinclair.

I notice that I have one of the earlier machines with 5 ICs, could this be "teething trouble" that has now been removed in the 4 IC models?

Yours sincerely,
E. Mullinger
8 Maynard Court
Clarence Road,
Windsor, Berkshire

Another Quirk

Dear Sir,

T. J. Dowling's revision of Joe Aitken's "Number Data" (Letters E&C M Jan. '82) bought a puzzling response from his ZX81 micro; that the integer of the square root of a number was recognised as equal to it's actual square root only in the case of certain square numbers (e.g. 4, 9, 16, 64 but not 25, 36, 49 and many others). My own ZX81 has the same inconsistency.

This perhaps goes with another quirk, recognised by Sinclair, in some ROMs where the instruction PRINT .125**2 gives the wrong answer.

In the meantime the program can be run successfully by deleting line 80 and writing in:

```
75 LET X = INT SQR A
80 IF X*X=A THEN PRINT AT 7,13;"AND
A SQUARE NUMBER."
```

Yours faithfully,
Pete Maguire
276 City Road
Birmingham B16 0NE
021 429 4242

P.S. Great Mag!!

CONTINUED FROM PAGE 22

Conclusion

Exotic peripherals such as slide projectors or video equipment often have to be interfaced to a microcomputer. Because no "standard" interfaces exist the problem is often solved by employing a variety of different ad-hoc interface systems. Most often these are implemented through the I/O ports made available by peripheral support chips. However, when the external I/O requirements of any particular situation exceed the capability of these chips an alternative scheme involving memory mapping can be employed. These different interfacing techniques have been illustrated by the design and implementation of circuits to enable the computer control of both sequential and random access slide projectors.

Image projection equipment of this type is often used in computer based training applications. The projectors enable a series of high resolution graphic images to be presented to trainees. Their understanding of the material embodied in the pictures is subsequently tested by multiple choice questions displayed on the computer screen. In order to control and coordinate the training resources many instructors use a special high level programming tool called an author language. This consists of a series of commands that control the various hardware items available. In the author language that we use (MUMEDALA) there is a command of the form SLIDE (P,N) which is used to control a bank of random access slide projectors. Execution of this command causes slide N to be shown on projector P. The way in which this command is implemented, via memory mapping, has been briefly outlined.

Computer controlled picture projection devices have a wide variety of applications in education, commerce and industry. They are particularly useful in situations in which the use of pictures greatly simplifies the process of communication — either between people or between a computer and its users. Currently there is much interest in the design of pictorial interfaces to information systems. Here use is made of pictures (rather than text or numbers) in order to specify the nature of the information that is to be retrieved and displayed. The success of these systems depends upon the high sematic content of pictorial images. This is adequately expressed in the well known adage, "a picture is worth a thousand words". ■

Fig. 6 Program for Automatic Slide Projection

```
100 DIM T(80), S(80)
110 POKE 59459,255
120 PRINT "□ ↓AUTOMATED SLIDE PROJECTION"
130 PRINT "***************************"
140 INPUT "↓↓HOW MANY REPEATS"; R1
150 INPUT "↓↓HOW MANY IMAGES"; S1
160 INPUT "↓DEFAULT DURATION"; D1
170 FOR I=1 TO 80 : T(I) = D1 : NEXT I
180 PRINT "↓DO YOU WISH TO SPECIFY THE
    ORDER"
190 PRINT "IN WHICH SLIDES ARE PRESENTED?"
200 PRINT "↓→→→→ ANSWER Y OR N"
210 GET A$ : IF A$ = " " THEN 210
220 IF A$="Y" OR A$="N" THEN 240
230 GOTO 210
240 IF A$="Y" THEN GOTO 270
250 FOR I=1 TO S1 : S(I)=I : NEXT I
260 GOTO 350
270 PRINT "↓↓ENTER THE SLIDE NUMBERS IN THE"
280 PRINT "SEQUENCE YOU WISH THEM TO BE
    DISPLAYED"
290 FOR I=1 TO S1
300 PRINT "↓→→→ IMAGE "; I; "↑"
310 INPUT "→→→→→→→→→→→→→WILL BE SLIDE"; S(I)
320 POKE 33637,32 : POKE 33638,32
330 PRINT "↑↑";
340 NEXT I
350 PRINT "□↓AUTOMATED SLIDE PROJECTION
360 PRINT "***************************"
370 PRINT "↓→HOW MANY SLIDES DO NOT
    HAVE THE"
380 INPUT "→→DEFAULT DISPLAY TIME"; N
390 IF N=0 THEN GOTO 500
400 PRINT "↓→ENTER THE DETAILS BELOW;"
410 PRINT "↓↓"
420 FOR I=1 TO N
430 INPUT "→→→→IMAGE NUMBER;" K1
440 INPUT "→→→→DISPLAY TIME;" K2
450 T(K1)=K2
460 POKE 33230,32 : POKE 33231,32
470 POKE 33270,32 : POKE 33271,32 :
    POKE 33272,32
480 PRINT "↑↑";
490 NEXT I
500 REM NOW CONVERT TIMES TO JIFFIES
510 REM AND CHECK FOR INVALID SLIDE
    NUMBERS
520 FOR I=1 TO S1
530 T(I)=T(I)*60
540 IF S(I) < 0 OR S(I) > 80 THEN 760
550 NEXT I
560 REM NOW COMMENCE OPERATION
570 PRINT "□↓EXECUTION BEGINS"
580 FOR I=1 TO R1
590 FOR J=1 TO S1
600 GOSUB 670 : REM GET PICTURE
610 GOSUB 720 : REM INVOKE TIMER
620 NEXT J
630 NEXT I
640 NS=0 : GOSUB 690
650 PRINT "□↓↓EXECUTION TERMINATED
660 STOP
670 REM ***RETRIEVE SLIDE
680 NS=S(J)
690 P=INT (NS/10)*16+NS-INT (NS/10)*10
700 POKE 59471,P
710 RETURN
720 REM ***TIMER ROUTINE
730 K=TI
740 IF TI < K+T(J) THEN 740
750 RETURN
760 REM *** ERROR REPORT AND ABORT
770 PRINT "□↓↓↓***INVALID SLIDE NUMBER
    SPECIFIED"
780 PRINT "***EXECUTION NOT POSSIBLE"
790 PRINT "***RUN ABORTED"
800 STOP
```

An entire range of low-cost high-performance instruments

sabtronics

'Making Performance Affordable'

*2010A	3½-Digit L.E.D. Bench DMM	5020A	1Hz-200KHz Function Generator
*2015A	3½-Digit L.C.D. Bench DMM	*8110A	100MHz 8-Digit Frequency Meter
2020	3½-Digit L.E.D. Bench DMM with Microcomputer Interface	*8610A	600MHz 8-Digit Frequency Meter
		*8610B	600MHz 9-Digit Frequency Meter
2033	3½-Digit L.C.D. Hand DMM	8000B	1GHz 9-Digit Frequency Meter
*2035A	3½-Digit L.C.D. Hand DMM	8700	10MHz Universal Frequency Counter/Timer
*2037A	3½-Digit L.C.D. Hand DMM with Temp.	PSC-65	600MHz Prescaler
LP-10	10MHz Logic Probe	9005	5MHz Single Trace Oscilloscope

* Also available in kit form.

Test our low priced test equipment. It measures up to the best. Compare our specs and our prices – no-one can beat our price/performance ratio.

Full colour illustrated brochure and price list from:
BLACK STAR LTD.,
9a Crown Street, St. Ives,
Cambs. PE17 4EB
Tel: (0480) 62440. Telex 32339

Black Star

PROJECT ZX 81

ROBOTIC ARM
CHURCH FAIR
AUTOMATIC – DOOR SYSTEM
PROCESSING
PROCESS TIMING
SHOP DISPLAY
ROBOTIC – TESTING

TEACH YOURSELF & OTHERS -CUT- INDUSTRIAL COSTS WITH MICROS TO PEANUTS

FROM G-M-S

THE CONTROL SPECIALISTS

FOR, student teacher enthusiast or engineer

ZX81 ROBOTICS SYSTEM

* 16 CHANNELS
* OUTPUTS RATED 1 AMP
* 8 AMP INTERNAL – 50va – POWER PACK
* JUST – PLUGS IN WITH MEMORY

ONLY £59-95 & £2-50 P&P -INCLUSIVE-

"PROCESS CONTROL"

YOU CAN RUN THE REAL THING OR SIMULATE ON A PROJECT BOARD

:EASY TO PROGRAMME:
:WITH APPLICATION BOOK:

G·M·S ELECTRONICS
TEL. -01 679 5205-
UNIT 5, CRANBOURNE CLOSE
NORBURY SW16 4NG

WE TURN ELECTRONIC TYPEWRITERS INTO COMPUTER PRINTERS

SILVER REED

OLYMPIA

OLIVETTI

If you have one of these, your local typewriter/computer dealer can arrange for the upgrade.
The discom upgrade enables most popular electronic typewriters to communicate with any micro computer.
Interfaces fitted as standard on each machine are: RS 232, Centronics IEEE.

* *Interfaced machines are available from your local dealer.*

discom
Old Manor Farm, Ashton under Hill
Worcestershire
Telephone (0386) 881962

Please send me more details
Name
Address

Telephone
ECM

MINI VE
IN SEARCH OF (

Mini Venture is designed to run on the UK101 with a new monitor and 7K of RAM but it can be run on other systems with a memory mapped display. Only minimal instructions are given in the program, but here are full instructions and a detailed program description.

You have entered a series of caves in search of gold but have managed to lose your way and cannot find the exit. There is food in the caves but your main worry is meeting one of the 'THINGS' that inhabit the caves. They come in three sizes and the bigger they are the harder they fall. If they get close enough they will leap on you and a fight will ensue. If your energy is low it will kill you. 'THINGS' will randomly appear from time to time in the tunnels between the caves — so don't hang about. The 'THINGS' do not live for very long and you may be able to out run them, but this uses up energy. To keep your energy high you need to eat as much food as possible but since you are greedy you still collect gold in case you escape. To help combat the 'THINGS' you have with you ten spells to blast them with. The spells have a limited range and are wasted if the 'THING' is out of range. More spells can be found in the caves. The more gold you collect the higher your final score but your energy will run down more quickly. Most of the gold is protected by 'THINGS' and since the caves are dark you cannot see what they contain until you reach the entrance. To pick up the gold, food etc. you move on to it and your status will be updated accordingly. The game ends when you are killed or run out of energy and die. Your final score is then displayed and this will depend on the amount of gold collected and the number of 'THINGS' killed.

The keys used to move during the game are:-

1 - Up **3 - Left**
2 - Down **4 - Right**

Pressing key 5 invokes a spell blast and the 'THING' responds accordingly. Spells vary in strength and it may take two or three to kill a large 'THING'. The keys used can be changed to suit your own personal preference by altering the keyboard scan routine at line 160-185. It isnot necessary to repeatedly press a key — especially when spell blasting since the action will continue as long as the key is held down. It is not possible to move in two directions at once or move and spell blast at the same time.

The program draws the caves onto the screen and holds their contents in the array RC(x). The contents range from a single item to two items and a 'THING'. The information held in RC(x) are converted to these items by the routine at line 7000. The entrance to each cave consists of a different blank code (96) to the normal ASCII code 32 — this means that the program can detect entry to a cave and enable the entry flag (IN). The 'man' is placed at the bottom of the display and can be moved around the three caves. The caves remain blank until the 'man' reaches the entrance when the contents are then displayed. If the cave contains a 'THING' the flag M is enabled and the 'THING' is moved each time the main program loops round. When the easy game is selected the 'THINGS' move in a more random manner than in the hard game. The main program loop is quite short and the player movement is therefore fairly fast. Time consuming subroutine calls are kept to a minimum or take place when the player has stopped eg to pick up food. The cave contents are changed each time the main program loops back to the beginning but they are only displayed when the player enters a cave. Table 1 lists the program variables used and Table 2 shows the various graphic symbols used. Table 3 gives a line-by-line description of the program and from this conversion to other systems should be fairly easy.

The UK101 uses a standard 8K Microsoft Basic and it's video memory starts at location 53248 and is formatted into 16 rows by 64 columns. Unfortunately only 48-50 columns are displayable and the variable SP is set to 53259 in line 130 and not 53248 to allow for this difference. The bottom line of the display is used for messages and this is cleared and POKEd to by the routine at line 3000. The top two lines of the display are used to show the total amount of gold, spells, energy and 'THINGS' killed. The position of the 'THING' and the player on the screen is determined by the value of MP and PP which are calculated from the equation SP+64*Y+X where 64 is the line length and X,Y the co-ordinates of the 'man'/'THING'. SP and 64 can be changed to suit other systems.

The subroutine at line 9000 draws the cav
screen and from the picture shown a scheme
video displays can be worked out. The Cl
command clears the screen and homes th
The keyboard scan routine is enabled and c
by the POKE in line 160 and can be replaced
or INKEYS on other systems and the IF st
in lines 165-185 changed accordingly. The

Table 1. (Program Variables)

YP, XP Y, P	Horizontal and vertical co-o player
PP, Z	Player position on screen
YM, XM	Horizontal and vertical co-o 'THING'
MP, W	Position of 'THING' on scre
D1, D2, D3	Cave entrance on screen
S, SP	Temporary screen positions
SP(0), SP(1), SP(2)	Position of top left hand cc
B(0), B(1), B(2), B(3)	Amount of spells, energy, f killed
RC(x)	Contents of each cave.
WW, ZZ	Contents of location W and
XX, YY	Direction of 'THING'
KE	Memory location of keyboa
M, IN	'THING' and entry flags
M$	Message to be POKEd to sc
MS$	String containing final scoi
CT	Number of battles before v
MC	Number of moves made by
B1, B2, B3, B4	Contents of screen around spell blast
HP	Energy of spell blast
EU	Energy level of 'THING'
EL, SL, GL	Levels of food, spells, golc
FP, SE, GP	Position of food, spells, g

:s on the
'or other
R$ (12)
cursor.
isplayed
by GET
tements
function

rdinates of

rdinates of

n

rner of caves.
od and 'THINGS'

Z

d

reen
e
ctory
'THING'
'THING' during

ld

[...]NTURE [...]GOLD

by Anthony Brown

Table 2 GRAPHICS CHARACTERS
Mini-Venture by A. Brown

CHRS() Code	Character	Use
4		Gold
9	▯	Food
10	▯	Clear bottom line
32	▯	Space
96	▯	Entrance space
128		Cave wall, top
135		Cave wall, bottom
136	|	Cave wall, right
143	|	Cave wall, left
161	█	Corridor corners
181		Medium 'Thing'
207	┐	Cave corner
208	┘	Cave corner
209	└	Cave corner
210	┌	Cave corner
240		Man
243		Small 'Thing'
245	Ψ	Spells
252	θ	Large 'Thing'

FNR(x) defined in line 120 produces a random number between zero and x. The function FNA(x) produces a random position within the confines of cave x., the left hand corner of which is defined in line 110. The two flags M and IN have a value of -1 if TRUE and 0 if FALSE. The IF statements that test these flags do not need a second argument eg IF M=(-1) . . . if they are being tested for TRUE such as in line 205. The USR(x) function waits until a key has been pressed and it's starting address is POKED in line 100. The PEEK statement after a USR function call determines the ASCII value of the key pressed. This function could again be replaced by GET or INKEYS.

The game can be made harder/easier by either changing the energy value EU of the 'THINGS' in lines 7095 and 260 or changing the value of the food and spells in line 7075 and 7080. The rate at which the player loses energy can be altered by changing the divisor in line 155 to a larger value to lower the rate and a higher value to increase the rate. The length of time a 'THING' lives is determined by the value of MC. When the 'THING' has completed 100 movements it dies and another will appear when the flag M is enabled. The 'THING' can be made to move more quickly by calling the movement routine at line 5000 more often in the main program loop i.e. between line 230 and 235.

MINI VENTURE PROGRAMME
Page 52 ▶

Table 3 - PROGRAM DESCRIPTION

100-260	Main program block
100	Enable user function; call instructions routine; initialise player
105	Screen addresses of the cave entrances
110	Disable flag M; screen addresses of cave corners
115	Initial spells and energy
130	Clear screen: erase cursor; set up screen
135-145	Set up score board
150	Randomly select cave contents
155	Reduce energy; update energy status only
160-255	Keyboard polling/player movement
185	If key 5 is pressed call spell blast routine
190	Move 'THING' if present
205-210	Toggle IN flag
215-225	Update status
235	Move player
240-250	Close entrance if open
255-260	Return to start of loop
1000-1035	Fight routine and end
1500-	Score board POKEing routine
3000-3005	Clear bottom line and POKE message
3500-3525	Update scoreboard
5000-5065	Move 'THING'
6000-6045	Spell blast
6010	Limits range of spell blast
7000-7100	Fill cave with items; determine level of food, gold etc.
8000-8075	Print instructions held in DATA statements
8025	Erase cursor
8150	Print string - justified to screen centre
8500-8565	Instructions held as DATA statements
9000-9070	Create caves on screen

16K RAM FOR ZX-81

Any new owner of the Sinclair ZX-81 soon becomes aware of the need to:
WRITE ONLY SHORT PROGRAMMES.
LEARN MACHINE CODE.
OBTAIN A RAM EXPANSION.
Sinclair, of course, market a 16K dynamic Ram expansion, but long delays in arrival, and reported unreliability have caused many to think twice (I was one of the poor unfortunates who after a couple of months wait had to send the Sinclair Ram back, and face and even longer wait for a refund).

The questions raised are:
HOW MUCH RAM?
STATIC OR DYNAMIC?
WHAT CAN I AFFORD?

After a lot of thought and enquiries I plumped for the dk'Tronics 16K Ram. This comprises of a Glass fibre, double sided PCB. There are 17 chips on board, 8 UPD416-C2 static Ram chips, 7 LS-TTL's, a 741 and a 12 volt regulator. This is a STATIC RAM unit and will therefore need a more hefty PSU than the Sinclair power unit, also the Ram chips require an additional 12 volt rail. dk'Tronics supply a suitable PSU with the 16K Ram pack at no extra cost!

The only drawback is that a higher voltage is needed for the 12v regulator, approx. 16 to 20v. This means that the SV regulator in the ZX-81 has to dissipate more power and will therefore run hotter.

Personally, I find a warm keyboard a little disconcerting, and so have taken my own measures to overcome this (the topic of a future article perhaps?!). Do not be dismayed it is all within the specification of the SV regulator and should cause no problems.

In use the Ram pack has given no trouble at all — I haven't run out of space, I have had no crashes, and no memory shrinkage. The unit is the same width as the ZX-81 and the well positioned edge connector ensures that the board fits well and doesn't rock; electrically and mechanically it is a very stable unit.

The cost including PSU is £42.95, and a recent advertisement shows it available in kit form for about £10 less, and if the initial outlay is still too high, they also supply a Ram Pack with IC sockets to enable you to start small and build up to the full 16K as you require/afford it.

dk'Tronics live at 23 Sussex Road, Gorlestone, Great Yarmouth, Norfolk.

A telephone call will evoke a polite and helpful response. Anyone for chess?

THE COMPUTE TEACHI

A friend of mine was recently advised by the local driving instructor that it would be very much better for his wife to have professional driving lessons as she could easily end up killing herself if she was taught to drive by her husband. He's had her out in the car for lessons twice a day since then. I'm not sure if he's hoping that the driving instructors prophecy will come true, or if he's joined the ever growing ranks of people who take the view that a professional is someone who can do for about £10 what the rest of us can do for a fiver!

This might be a rather severe attitude to adopt towards the educational scene where so much excellent professional work goes on in schools throughout the country, but armed with your home computer you are now on at least equal footing with teachers who, especially in primary schools, are not yet able to use micros in their day to day work with the children. An increasing number of young children are now arriving for their first day at primary school with a good knowledge of letters and in some cases simple words, which they have acquired through the patient and understanding interest that their parents have taken in their educational development during the pre-school years.

If you want to begin to evolve your child's literary skills then the place to start is with "building blocks" of the written word; the letters themselves. Here is a program that has been very successful in familiarising young children with letters, as it requires them to look at the letter presented to them by the computer, and then touch that same letter on the key board. This will probably be the first time that daddy's pride and joy has been allowed to sit down with his other pride and joy — his computer, so the motivation for the child to succeed will be high, and this is the time when the maximum educational benefit can be obtained.

One of the beauties of this program is that the young child does not need to be able to name the particular letter that shows on screen, it's simply a case of shape recognition as we saw in a previous feature. In this case though I would be tempted to tell the youngster the name of the letter as it appeared on screen, thereby teaching the letter while the child studies its form and shape as he compares the on-screen shape with the letters on the keyboard.

Letter recognition program:-

```
10 LET A = INT (RND-64)
20 IF A<38 THEN GOTO 10
30 PRINT AT 5,0; "Touch this letter"
40 PRINT AT 10,15; CHRS 1
50 IF NOT INKEYS ± CHRS A THEN     GOTO
50
60 PRINT AT 12, 12; "Correct"
70 FOR L ± 1 TO 50
80 NEXT L
90 CLS
100 RUN
```

After a few weeks at school your child will set out on the long road to literacy and you'll be the first to know when that memorable day arrives, for the entire evening will be devoted to a search for "A tin to keep my words in." Now, if father is a "roll your own fanatic" then there is no problem for it's either the Golden Virginia tin or the Strepsils tin, but in the non smoking household chaos reigns until a suitable container is found.

These precious words are written on "Flash Cards" to teach the child the pattern of the letters that go to make up the word, and it's a system of teaching words that lets the child pick up the words very quickly indeed, for they are soon able to name each word as they pick it out of the tin. It's a long and laborious process for the infant teacher to write out each word 30 times and pop one

HOME
R AS A
NG AID

By Joe Aitken

into every child's tin, and so the whole process is taken a stage further and the words are given to the children, printed in a book, which is great if your objective is to teach actual reading, but if you are wanting to teach individual words then it's definitely second best.

Every teacher has their own individual method for reinforcing those awkward words. These range from the rap over the knuckles of yesteryear to the up to date computer assisted learning used in a few schools. Now no matter which method is used in your child's school you can be right up there with the most up to date and successful methods, if you take the words that your child is having some difficulty with, or the set word for that night's homework, and feed them into a program like this:-

```
Flash card program:-
2 PRINT "Bus"
3 GOTO 25
4 PRINT "Brian"
5 GOTO 25
6 PRINT "Stop"
7 GOTO 25
8 PRINT "Julie"
9 GOTO 25
10 PRINT "Post"
11 GOTO 25
12 PRINT "Office"
13 GOTO 25
14 PRINT "Road"
15 GOTO 25
16 PRINT "Street"
25 FOR A ± 13 TO 20
26 PRINT AT 13, A; CHRS 138
27 NEXT A
28 FOR Y ± 0 TO 40
29 NEXT Y
30 LET Z ± INT(RNDx9) x 2
35 CLS
37 UNPLOT 25, 18
40 GOTO Z
```

During the initial runs you will have to tell the little one what the word is as it appears on screen, but after a few runs the child should be beating you at it and telling you what the word is. The trick is knowing just how long to hold off saying the word during the initial teaching runs, and this comes with practice, but do remember that if the child does not know the word, and you do not tell him what it is while it's on screen, then don't worry for it will appear again in the random pattern and you can tell the child what it is at that time.

Talking of recognising words leads me to this month's mini competition. I got a letter from a reader who says that his ZX81 is a x$/xer at loading. Now I reckon to know most of the abusive words on the go but I can't find one with the first and fourth letters the same, perhaps some of our Aussie readers will be able to help. This really takes us well away from our young children and on to the promised graphics program for science and technology students. It's always a difficult thing to describe electron flow to a student. I've seen it done with coloured marbles, felt tip pens or copious amounts of chalk and a handy blackboard duster, but until I used a micro none were very successful.

BLACK GRAPHIC

I like to describe a transistor as being rather like a main road, with a side road leading off. Most of the cars travel down the main road, while a few turn off into the side road. This works well so long as all of the cars keep moving, but if one stops then the whole of the traffic flow stops until such time as the stopped car moves on. The main road is the collector-emitter current which shows on screen as the moving black graphic; the side road is the base current and shows as a grey graphic. This program shows the flow pattern in the transistor and by touching key S you can block the base current and demonstrate that the collector-emitter current flow is also blocked; to clear the blockage touch key G and the normal flow will return. It is a good way to introduce students to the working of a transistor.

You can use a similar program structure to show many other instances of current flow, such as series/parallel arrangements or the operation of a switch. In every case the computer will have enabled you to take electrical current flow out of the area of abstract study and present it in an attractive, visual and easily understood way.

The working of the N.P.N. transistor

```
5 PRINT AT 2,13; "Collector"; AT 9,4;
"Base"; AT 18,13; "Emitter"; AT 9,16;
"NPN Transistor"
10 LET A ± 21
20 LET B ± 24
30 LET D ± 19
40 LET E ± 22
50 FOR N ± 9 TO 35
60 PLOT A,N
70 PLOT B,N
80 NEXT N
90 FOR M ± 13 TO 21
100 PLOT M,D
110 PLOT M,E
120 NEXT M
130 UNPLOT 21, 20
140 UNPLOT 21, 21
145 FOR A ± 1 TO 18
150 PRINT AT A,11; CHRS 128; AT A-
1,11; CHRS 0
160 NEXT A
165 LET B ± B×1
167 IF B/10 ± INT(B/10) THEN
GOSUB 300
170 GOTO 145
300 FOR A ± 1 TO 11
310 PRINT AT A,11; CHRS 136; AT A-
1,11; CHRS 0
320 NEXT A
325 IF INKEYS ± "S" THEN GOTO 500
330 FOR B ± 11 TO 5 STEP -1
340 PRINT AT 11,B; CHRS 136; AT 11,
B×1; CHRS 0
345 IF B ± 11 THEN PRINT AT 11,
B×1; CHRS 5
350 NEXT B
370 RETURN
500 IF INKEYS ± "G" THEN GOTO 330
510 GOTO 500
```

OK1-PRINTER OFFER

Serial Dot Matrix Printers

MICROLINE 80

Interface Section

The Microline 80 includes a Centronics compatible parallel interface which connects with TRS-80 ™, APPLE® and other popular small computers. RS232C serial interfaces are also available with a choice of speeds and buffer sizes.

The Microline 80 offers business quality and realiability at a price attractive even for personal use.

Crisp, clear print is produced on plain paper with a dense 9 x 7 dot pattern. In addition to normal upper and lower case, ten character per inch, eighty column printing, the Microline 80 provides the user with the option to print both double width and condensed characters. Six or eight lines per inch spacing are also standard. Front selection, character pitch and line spacing are all program controllable.

Graphics

Graphics capacity is included at no extra cost. Charts, graphs and illustrations may be printed with captions of double width characters. The Microline 80/82A prints 64 block shapes in addition to the full upper and lower case 96 character ASC11 set. The block shapes may also be used to create special sets.

Interfaces

Parallel, Centronics compatible; Standard Serial, RS232C; Optional Current loop; Optional.

Standard Features

- 80 cps
- 80 columns with standard characters
- 132 columns with condensed characters
- Graphics
- 200,000,000 character head warranty
- Connects to TRS-80 ™, APPLE®, others
- Continuous operation
- Plain paper — up to 3 parts
- Full 96 character ASC11 set
- Double width characters
- 6 and 8 lines per inch
- Paper tear bar

MICROLINE 82A

Business Quality Printing

The Microline 82A prints bidirectionally at 120 characters per second and includes short line seeking logic that can increase throughput by. 80% over equivalent unidirectional printers. A dense 9 x 9 dot pattern is used to produce crisp, clean copies, first copy to last.

The nine pins in the head are "fired" using energy stored in tension members. This technology permits the use of short, low mass pins made with an extremely hard alloy. The head produces less heat, thereby extending its life.

In addition to normal upper and lower case, ten character per inch printing, the 82A prints both double width and condensed characters at six or eight lines per inch. Font selection, character pitch and line spacing are all program.controllable.

Dual Interfaces

The Microline 82A is offered with both Centronics-compatible parallel and RS232C serial interfaces as standard equipment. The parallel interface operates with TRS-80 ™, APPLE® and other popular small computers. The standard RS232C serial interface operates at speeds to 1200 bps. Other serial interfaces are available with switch-selectable speeds to 9600 bps and a choice of buffer sizes. IEEE 488 parallel and current loop interfaces are also available.

Three Printers in One

Microline 82A users do not have to purchase different modles for different forms. The standard platen accommodates friction and pin feed forms and optional tractors snap in place and adjust to suit form width. The Microline 82A provides versatile forms controls including vertical tab, top of form and a vertical format unit that provides switch and program selection for up to ten form lengths.

Standard Features

- Bidirectional
- Short line seeking
- 80 columns with standard characters
- 132 columns with condensed characters
- Graphics
- Duel interfaces
- Operates with TRS-80 ™, APPLE®, others
- Plain paper — up to 4 parts
- Full 96 character ASC11 set
- Double width characters
- 6 and 8 lines per inch
- Paper tear bar

To Printer Offer, E&CM, 67 High Street, Daventry. Northants NN11 4BQ.

		Qty	unit price	Total
CASH	Microline 80 Printer incl VAT/Delivery		£298.99	
	Microline 82A Printer incl. VAT/Delivery		£458.85	
	Serial Interface for Micro 80		£95.75	
CREDIT	Microline 80 Printer incl VAT/Delivery Deposit per unit £29.63 Microline 82A Printer incl. VAT/Delivery Deposit per unit £45.89 Microline 80 with serial Interface VAT/Delivery Deposit per unit £39.32			
HOW TO Order	Credit Customers — enclose cheque/PO for deposit and pay 10 monthly installments. Cash Customers — enclose cheque/purchase order for full amount which includes VAT/Delivery by Securicor. Delivery — Cash customers allow 10 days. Credit customers allow 14 — 21 days.			

Name ....

Company (if applicable) ....

Address ....

....

DEFERRED PAYMENT SCHEME

MICROLINE 80

Eleven payments of £29.63 a month (£39.32) if serial interface required).

MICROLINE 82A

Eleven payments of £45.89. Credit customers pay 10% extra based on the amount they borrow. equivalent A.P.R. 23.4%). Total credit price: **Microline 80 — £325.93 incl. VAT/Carriage. Microline 82A — £504.79 incl. VAT/Carriage.** With the extra serial interface for the Microline 80 the total cash price is £396.74 and the total credit price is £432.52.

4 RAIL MICRO COM POWER SUPPLY

The present design arose from my own need for a reasonably heavy-duty unit to supply a NASCOM 2 microcomputer with 64K memory. To allow for further expansion I decided that the +5V rail should be capable of supplying about 5 amps. The unit is fairly compact and should fit into the larger type of computer case. However if it is mounted in its own separate enclosure then it may double as a general purpose Power Supply, the voltages provided being suitable for much popular circuitry.

Regulated Outputs are:

+12V at IA
+ 5V at 5A
- 5V at IA
-12V at IA

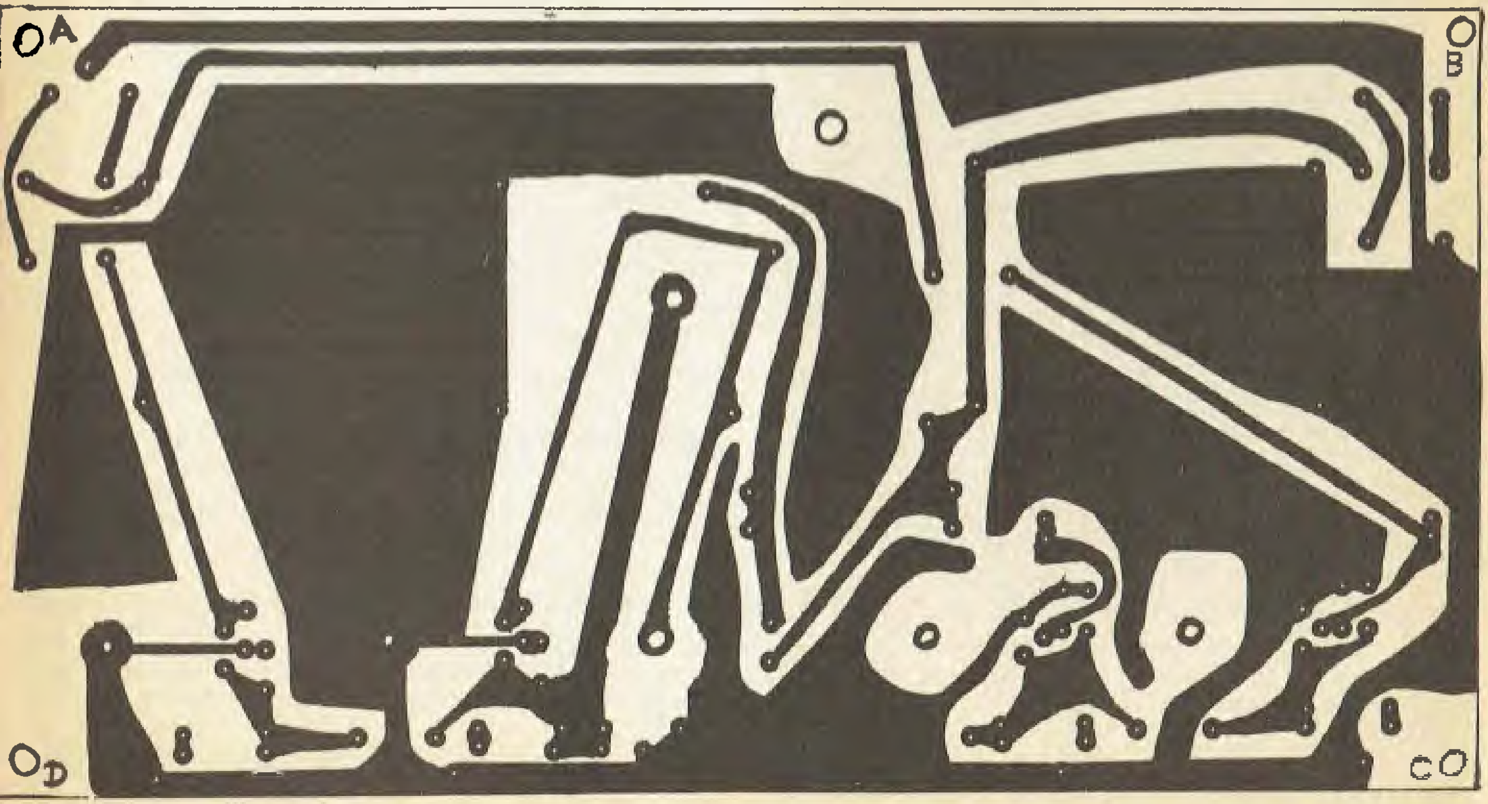
P.C.B. ▽

Design Considerations

Although many IC's used in computer circuitry operate from a single +5V supply, there are still a great many memory devices (for instance the 4116 Dynamic RAM and 2708 EPROM) which require additional supplies at +12V and -5V. As the almost universal RS232 interface (used for teletype, printers etc.) requires +12V and -12V this means that a computer P.S.U. to be really useful must have 4 well-regulated output voltages with the +5V rail being capable of handling quite heavy currents.

A problem which has received less attention in the popular journals than perhaps it merits is that of mains-borne interference. Electro-mechanical equipment generates switching spikes which, carried by the mains, can be very troublesome and even damaging to computer circuitry. In industry, where computers may of necessity be situated near lathes, drills, pumps etc., such spikes or 'transients' may appear as spurious data, and in extreme cases may cause the destruction of MOS devices whose enormous input impedences make them peculiarly susceptible to this problem. Even the personal computer at home can be affected, as anyone will be aware who has ever entered a long programme by hand only to lose it all when the central-heating switched on!

Rather than find space for an extra P.C.B. I decided to use a suppressed mains chassis plug (Siemens type K141) with a VDR (Voltage Dependent Resistor) as an added protection against transients. The latter is a semi-conductor device which presents a high resistance to voltages below a certain threshold (in this case 400V peak) but a low resistance to voltages above that threshold. As the device 'turns on' very quickly it provides a very useful protection against sudden peaks.



PUTER

by Tony Doherty

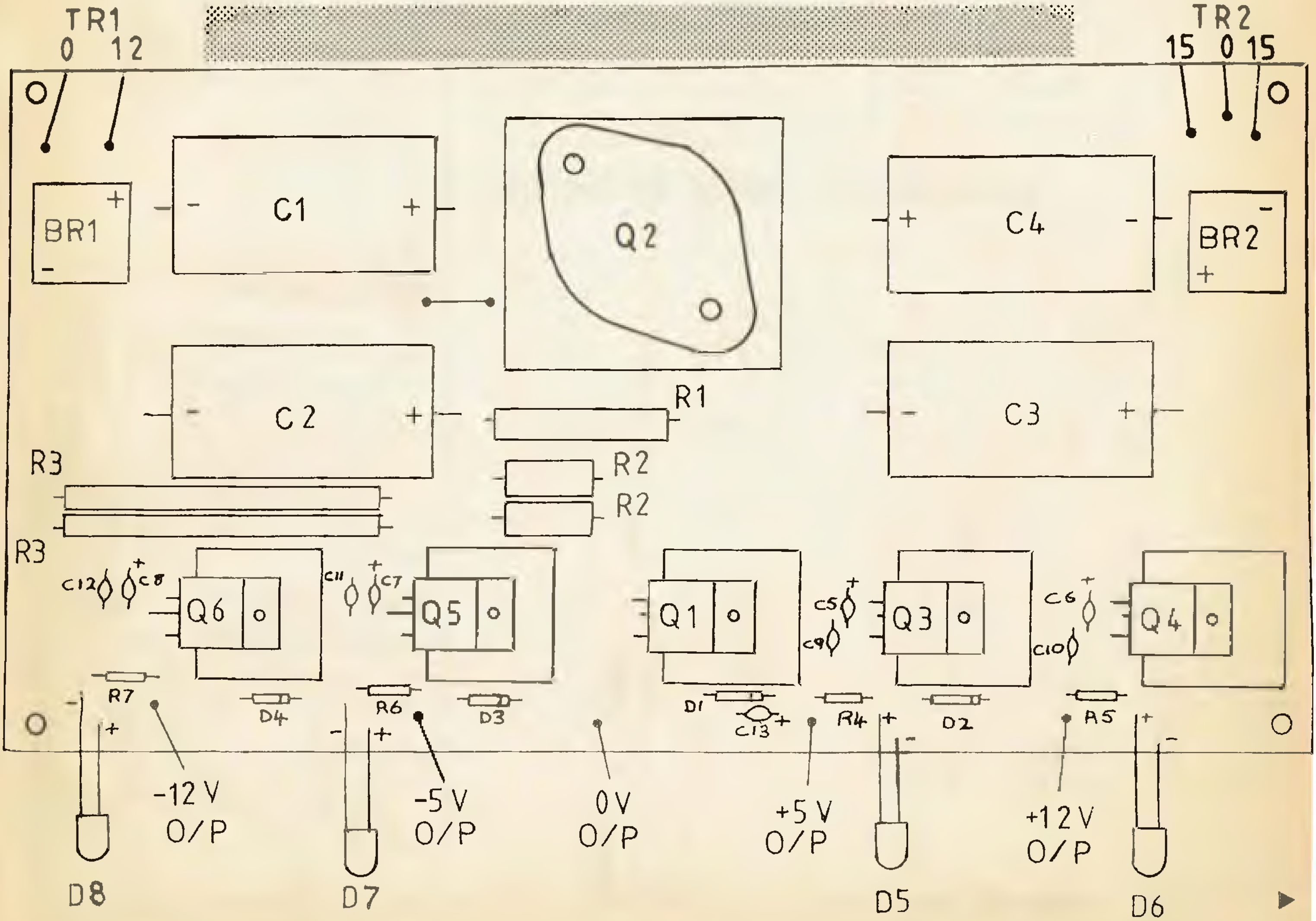
The Circuit (SEE PAGE 44)

The well-known 78 series (positive) and 79 series (negative) regulators were chosen to provide the 4 stable voltages required. These devices are internally protected against overload and are also reliable and inexpensive. Each regulator drops 2½-3V internally and therefore the unregulated supply to each must be at least this margin higher than the required output voltage.

Because of the different power ratings of the four rails and the difficulty of obtaining a transformer with suitably wound secondaries I decided to use two separate transformers. A 15V Toroidal supplies the three 1A rails. The secondaries are connected in series to give a 15-0-15 supply. This is rectified by BR2 and smoothed by C3,C4 to present partially regulated supplies to the three monolithic regulators Q4,Q5,Q6. R3 drops some of the unwanted voltage to the -5V regulator, reducing the heat dissipated by the device.

The heavy-duty +5V rail is derived from a 12V 80VA Toroidal with secondaries connected in parallel. The output is rectified by BR1, smoothed by C1,C2. A 7805 holds the output at +5V but can only supply about 1A. The rest of the current is passed by the power transistor Q2, with Q1 providing current limiting. R1 provides bias current for Q2 and Q2's collector is held at +5V by the 7805. Q1 provides current-limiting as follows. When the current through Q2 is less than about 4A the voltage across R2 is insufficient to turn on Q1 and the transistor is accordingly inactive. As the voltage across R2 rises to

COMPONENT OVERLAY ▽



■ *(Continued from Page 43)*

about .7V the transistor starts to conduct, reducing the Base-Emitter voltage of Q2 and limiting the current through the latter.

Diodes D1-D4 are included in the circuit to prevent a possible latch-up on switch-on, where one regulator might start up faster than the others and force an adjoining rail into reverse bias.

The LED's D5-D8 show that a voltage is present at each output. They may be mounted on the front panel of whatever enclosure is selected or if inconvenient may be dispensed with altogether — though they do usefully monitor the state of the power-supply.

Construction

Few difficulties should be encountered provided one observes the polarity of diodes and electrolytic capacitors. However the following points should be noted:

1. The +5V rail and the earth return rail carry quite heavy currents. If you are making your own PCB this should be allowed for in the width of track allocated.
2. Q1, Q3 and Q4 are connected via their back-plates rather than by their centre pins. The centre pins should be cut off short.
3. Q2's collector is connected to the PCB via one of the fixing screws. This is normal in a T03 package — the collector being connected internally to the metal case.
4. All transistors and IC's are heat-sinked as are the two bridge rectifiers. The heatsinks should be bolted to the rectifiers before the latter are soldered to the PCB.
5. The transformers should be connected as follows:
   TR1: Red and blue connected together; Grey and yellow connected together.
   TR2: Blue and yellow connected together.
   The transformer secondary leads are quite thick and you may need a heavier bit on your soldering iron to get a good connection.
6. The PCB requires one wire link.
7. The power outlets may be hard wired to your computer bus or may be fitted with terminal pins.
8. The VDR may be soldered across the live and neutral terminals of the chassis socket.
9. 2A anti-surge fuses should be fitted in series with mains live and neutral.

Stand-Alone Construction

The whole PSU will fit NEWRAD Case type 2/37:

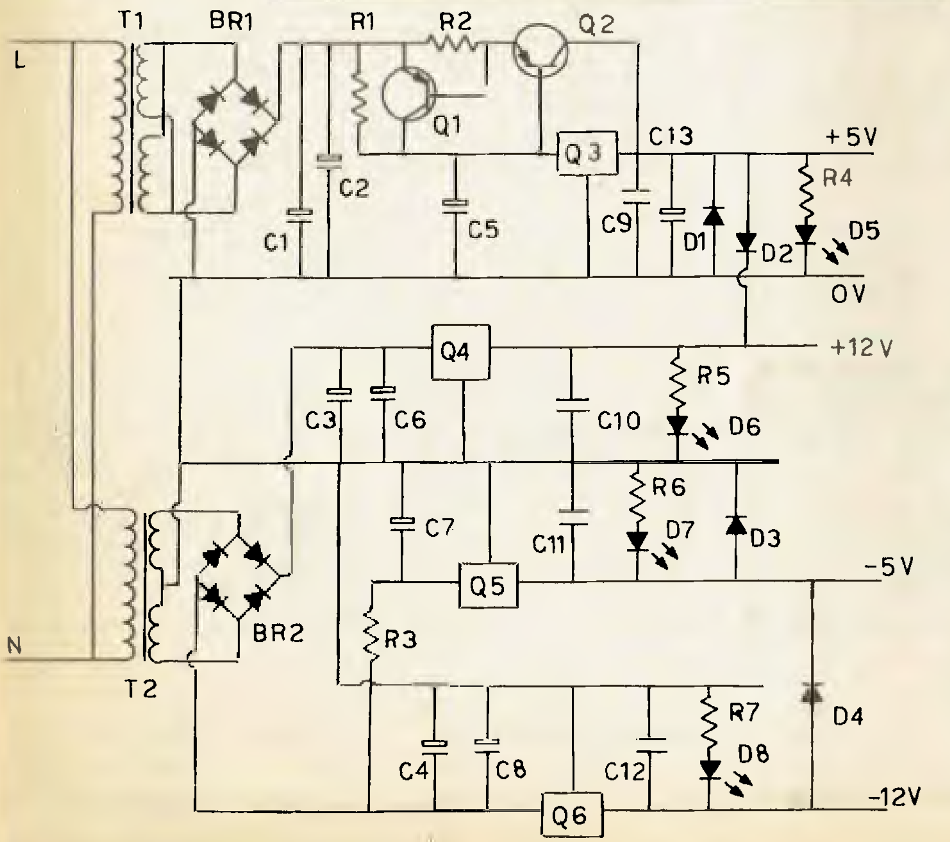
The two transformers should be mounted between the floor of the enclosure and the free chassis plate using the fixing bolts supplied with the transformers.

The PCB should be mounted on top of the chassis plate using ½" tapped pillars (6BA). Make sure the transformer fixing screws do not touch the PCB.

The chassis plug and fuse holders may be fitted to the rear panel. The power outputs (including 0V) should be brought out to insulated terminals mounted on the front panel. The four LED's may be mounted directly over the appropriate power outlet.

A single earthing point should be mounted on the chassis to which mains earth and 0V should be connected.

4 RAIL P.S.U.



Parts list

R1 : 2R4, 3W.
R2 : 2 x 0R22, 2½W, connected in parallel.
R3 : 2 x 15R, 7W connected in parallel
R4 : 200R,
R5 : 750R
R6 : 200R
R7 : 750R

C1, C2 : 4,700μ/40V electrolytic.
C3 : 2,200μ/40V electrolytic.
C4 : 4,700μ/40V electrolytic.
C5-C8 : 2.2μ/35V tantalum.
C9-C12 : .1μ Ceramic.
C13 : 10μ/25V tantalum.

BR1, BR2 : BR64 (6A).
D1-D4 : 1N4002 (1A silicon diodes).
D5-D8 : LED's to suit.
Q1 : TIP42A
Q2 : MJ2955
Q3 : 7805
Q4 : 7812
Q5 : 7905
Q6 : 7912

Miscellaneous

TR1 : 80VA 12V Toriodal (ILP type 32012).
TR2 : 80VA 15V Toriodal (ILP type 32013).
VDR : 240V RMS rating (RS Components).
7 small heatsinks for X75 package — Electrovalue type TV4. T03 heatsink — Electrovalue type TV3 Vero Pins; 20mm Fuseholders; 2A anti-surge fuses; suppressed chassis socket Siemens type K141; insulating bushes for MJ2955; 4 LED's and mounting bushes.

Extra parts for stand-alone construction

NEWRAD instrument case type 2/37;5 insulated 4mm terminals (Electrovalue type TP1) — choose different colours to distinguish the outputs; 4 x 6BA ½" tapped pillars; 8 x 6BA ¼" screws,

All parts used in the project are stocked by Electrovalue Ltd., but most are fairly standard and should be readily available elsewhere. ■

JOSEPH SPENCER & PARTNERS LTD

offer

The Sensational SHARP MZ-80K

on a basis everyone can afford

NOW ONLY

£39.90 PER MONTH

Deferred payment scheme

For 11 payments of only £39.90 this top quality MZ-80K can be yours!

Competitive finance

We have negotiated a very competitive interest rate for this scheme with Musters Finance of Nottingham. Credit customers will pay only 10% extra, (equivalent A.P.R. 26.4%). So the total credit price is £438.90 to include V.A.T. and delivery, as opposed to the cash price of £399.00.

What to do next

If you wish to use the credit scheme, just complete the order form and send it with the deposit to us. We will send you a simple Musters loan form to complete. When you return this, we will arrange despatch of your MZ-80K.

OTHER JOSEPH SPENCER & PARTNERS PRICES

	NETT	V.A.T.	TOTAL
MZ I/O Expansion Interface	96.00	14.40	110.40
MZ80 F.D. Dual Disks	560.00	84.00	644.00
MZ80 F I/O Disk Interface	52.00	7.80	59.80
MZ80 FMD Master Disk and Manual	20.00	3.00	23.00
MZ80 F15 Disk Cable	8.00	1.20	9.20
MZ80 FOS Extra Disk Cable	7.00	1.05	8.05
MZ80 P3 Dot Matrix Printer	365.00	54.75	419.75
MZ80 T20C Machine Language	18.00	2.70	20.70
MZ80 TU Assembler	36.00	5.40	41.40
MZ80 T40E Pascal	40.00	6.00	46.00
MZ80 I/O-1 Universal Interface Card	40.00	6.00	46.00

Mail Order Form

Enter all items you require together with the price. Total all items for CASH PRICE. Despatch order with cheque payable to Joseph Spencer & Partners Ltd. Credit customers add 10% to cash price- Divide CREDIT PRICE by 11 to give deposit. Seend cheque for this amount with your order.

Goods required	Price
1	
2	
3	
4	
5	
6	
Total cash price	
Credit — add 10%	
Total credit cost	

Name ______________ Tel: (day) ______________

Address: ______________

______________ Post Code: ______________

MAIL TO: JOSEPH SPENCER & PARTNERS LIMITED
18 Hamilton Road, Nottingham 603046 - 607395

ECM

Generating electricity from the wind without moving parts

by J. de Rivaz

Generation of electricity from the wind is well known. Usually a propellor is turned into the wind, and is used to turn a generator. Sometimes this is via a step up gearbox or belts. Problems arise because of the need to turn the propellor into the wind. As the machines twists and turns in gusts, gyroscopic forces put an extra strain on the tower, which also carries the large weight of the generator.

One modification to get over these gyroscopic forces is used on a machine called the Trimblemill. This uses contra-rotating blades. This also means that no step up gearing is needed as the generator has both field and armature rotating in opposite directions. However, there is a high cost to be paid for this technology, and sets are of the order of 64p per peak watt for a 12.5 kW machine. This does not compare favourably with the potential of solar electricity, but it is available now rather than in the future.

Another alternative is the vertical axis machines. These use vertically mounted propellors, that don't need pointing into the wind. A single rotating column can be the combined mast and shaft to drive a generator, mounted with the shaft vertical, on the ground. Some designs have the advantage that the blades feather individually, so when the wind drops in gusty conditions they don't waste energy by acting as blowers. Others have variable geometry, so that in high wind speeds they can still generate energy, but don't run so fast as to fly apart. Horizontal axis machines have to shut down after the wind gets to a certain speed.

However, which ever way one does it, rotating machinery held high aloft is always a potential danger and is going to need regular and careful maintenance.

Therefore if a static method can be found to generate electricity from the wind, then it will be at a distinct advantage, especially if it is cheaper as well.

The first time

the writer heard of this possibility was in an obscure magazine that was originally about "alternative technology", called Undercurrents. In the issue No. 12 a few lines described an electrostatic aerogenerator made by a M. Clitton in France. The whole thing seemed rather unlikely and was only given passing thought.

However in January 1978 an article appeared in the Institution of Electrical Engineers' monthly magazine "Electronics and Power" called "Sparks from Steam". This described how static electricity was made in the 1840s from jets of steam. The largest generator was of considerable power. However, it is not easy to convert high voltage high impedance DC to more useful levels of AC voltage and current, so the matter was never taken up. Mechanical generation became the norm.

Then in March of that year, a further article appeared in "Electronics and Power" describing the work of the Marks Polarised Corporation (153-16 Tenth Avenue, Whitestone, NY 11357, U.S.A.) This corporation, under its president Alvin M. Marks, is researching into a "Charged Aerosol Wind/Electric Power Generator". At a symposium on electrohydrodynamics at Colorado State University in January 1978 Mr Marks presented a paper on experiments on using charged water droplets to generate power from the wind.

These droplets are pre-charged and emitted into the wind stream. As they are blown away from the emitter, work is done on them by the wind moving them along a potential gradient between it and the ground. The electrical load is connected between the source and the earth, ie there is no collector electrode as such. An experimental nozzle was built that gave an output of 312 microwatts for a charging power of 86 microwatts.

It is suggested in the paper that a large area electrode screen would generate 450 w/sq.m in a wind of 10 m/s.

The problem of D.C.

However, even if one has the power available, it will still be a high voltage D.C. The technology to convert this to a low voltage A.C. at 50 Hz to power domestic appliances is likely to be expensive. Electrostatic motors are possible, but again it is unlikely to be practical to have an alternator driven by such a motor.

The Undercurrents article first mentioned discussed an AC machine. In this system, "electrostatic packets of air" are injected into the windstream, and collected by a grid downstream. As they pass through this grid, they are said to induce alternating potentials. The frequency depends on the velocity of the wind and the velocity of the injecting potential. The inventor suggests that a constant output can be obtained by controlling the injector frequency by electronic servo.

It is difficult to see why in this case the output would alternate around zero as opposed to pulsing unidirectionally from zero — something quite different. In order to get AC it may be necessary to alternate, rather than just pulse, the injector potential.

Also, it is clearly better to use the earth as the collector. Aiming the particles at a grid implies that the wind direction is important.

Suggested lines for experiment

A convenient source of high voltage is a capacitor discharge ignition unit feeding a car coil. Two units could be used, one giving positive pulses, the other negative. The two units would be driven from a two phase oscillator, so that they come on alternately.

This unit would be placed at the high voltage end of the primary of a transformer converting 100Kv to 240v. A re-chargeable battery would also have to be floated at the high voltage end to provide start up current. Of course once the machine started, this battery would be charged from generated current from a winding on the transformer.

It is not known at present what limitations there are on frequency. However, the higher the frequency that could be generated, the smaller and cheaper the transformer required. Televisions include apparatus to generate about 25kV at 15.625kHz and subseqently rectify it.

This idea was presented to the IEE in the form of a letter by the writer, which was published in June 1978.

In October a further letter appeared suggesting some snags. The main one seemed to be that the internal impedance of the system would be high — of the order of hundreds of millions of ohms at 50 Hz per electrode. (This means you need a great many electrodes!) Another relating to this is the coupling between the charged particles and the air. Energy can only be extracted by slowing the air down, and with a charged particle generator this has to be done by the charged particles.

However, one possible alternative was suggested. That is using ionised air instead of charged particles. If every molecule were singly ionised the charge would be 900 coulombs per litre. It is unlikely that this theoretical maximum could be reached, but nevertheless it appears better than the case with aerosols. With aerosols, Mr Marks suggest that the optimum radius/ no of electrons per droplet is 120 Angstroms/ I electron. But the charge per electron is 1.6×10^{-19} coulcombs!

Unfortunately, the practicality of apparatus involving ionised air working in all weathers is not good.

Conclusions

The main problem with power from the wind is that this power is very diffuse. Mechanical methods of collecting it involve large expensive structures. When electrostatic methods are considered, this problem turns to one of high impedances. This means the difficulties of large structures become the difficulties of dealing with high voltages.

Nevertheless, the cash rewards for a cheap domestic aerogenerator are large. If an effective design can be found, the government will have less justification for the nuclear programme, with its attendant problems. Also, a large factor in inflation, fuel costs, will be reduced. ■

A Digital Logic Probe

by Harry Fairhead

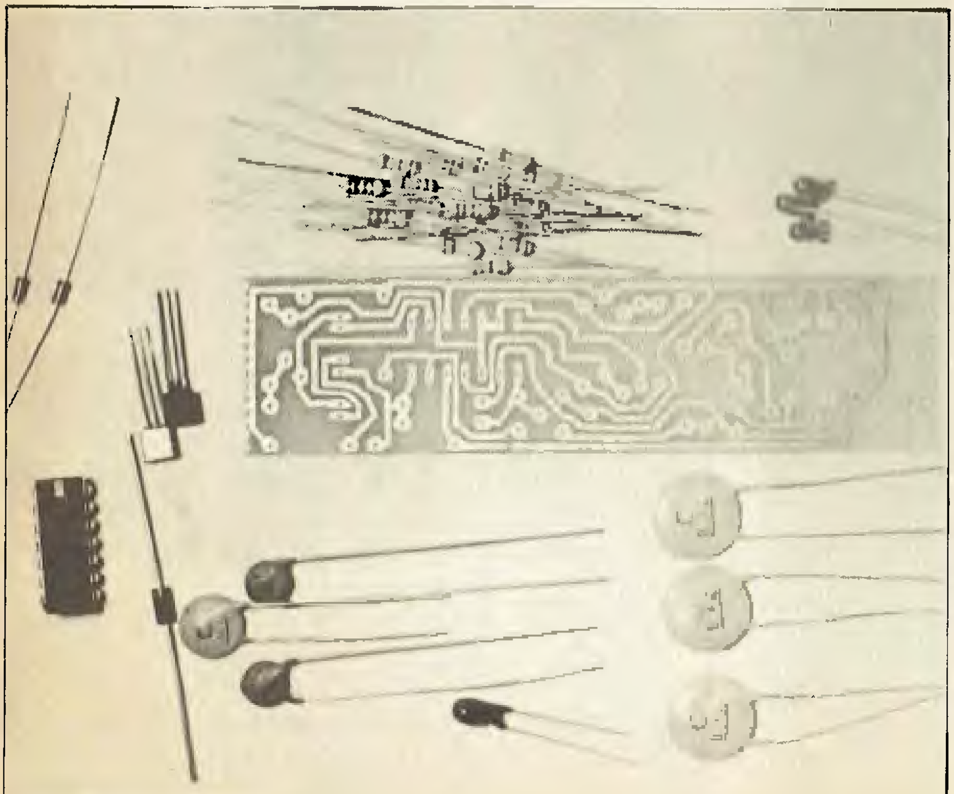
The kit under review this month is Global Specialties Corporation's Logic Probe Kit, LPK-1. Why build a logic probe from a kit? Well, first let's see why you might want a logic probe in the first place. A logic probe detects and displays logic levels, pulses and pulse trains. In other words it indicates the logic state of any point in a circuit. This makes it a useful piece of test equipment for digital repair work or for commissioning new circuits.

The advantages that a logic probe has compared to its alternatives, a logic analyser or an oscilloscope, are that it is easier to use; that is easily portable, which makes it suitable for field maintenance applications; and very much cheaper. While you'd need thousands of pounds for a logic analyser, and hundreds of pounds for an oscilloscope, you can buy a rudimentary logic probe for under £20. For this reason alone the logic probe is likely to be the one piece of digital test equipment that an enthusiast will acquire.

The question of financial outlay brings us to the reason why you might prefer to build a kit to buying a ready assembled logic probe -- you can make a worthwhile saving for just an hour or so's work. In the case of GSC's products you can save over a third of the purchase price of the built logic probe by putting the kit together. While the kit costs £15.52 (including VAT and postage and packing) the finished article (which is the LP-2) costs £22.14 (inc.).

If you are keen to make limited funds stretch, why not go the whole hog and build a logic probe from scratch? This is certainly a possibility. The main snags are making your circuit fit on to a small enough board and in finding a suitable casing. A logic probe has to be the right size and shape to be hand-held. I have seen the tubes that single cigars are sold in used as cases, but for the professional finish GSC actually sell a purpose designed case (for £4.88 inclusive of VAT and postage and packing).

There are a variety of logic probes available so how do you choose between them? In general, the more you pay the more sensitive the probe you'll acquire. GSC market a range of probes and this kit is at the bottom end. The main way in which the more expensive probes differ is that they can detect much faster signals. Once built the LPK-1 will detect a minimum pulse width of 200 nanoseconds while the LP-3, at £58.08 (inc) will capture pulses as narrow as 10 nanoseconds. (Ten nanoseconds is the fastest pulse that can be generated by TTL logic). All the GSC probes are suitable for TTL, DTL, HTL and CMOS logic levels. If you want a probe that is dedicated to just one of these types then you will be able to get a more powerful probe for less cost.



■ P.C.B. & Components.

The LPK-1

The kit comes neatly packaged on a piece of stiff card. Once you've got through the plastic wrapping you'll discover a booklet of instructions for building and operating the probe, Its grey plastic case, a printed circuit board cut to the correct shape to fit inside (it is in fact packed inside the case) and all the components packed together in one plastic bag (also contained inside the case). The components comprise seventeen resistors, eight capacitors, three diodes, three LEDs, two transistors, one integrated circuit and a number of additional bits of hardware (including the PCB, the probe tip, a power cord and adhesive labels and of course the case). Although the electronics components would cost you only about £3 and would be readily available, it is these other bits and pieces that would be more difficult to obtain or substitute for.

In addition to a comprehensive parts list, the instruction booklet gives a page showing diagrams of each type of component, and a resistor colour code chart. In this aspect the kit is an especially suitable one for a beginner. On the other hand there are no instructions on how to use a soldering iron which other beginner's kits often include — the instructions simply advise that to keep the soldering iron tip clean it should be wiped often with a sponge.

Rather than the usual wordy instructions, the part of the assembly instructions about placing components on the PCB is all covered in two anotated diagrams. These are very clear but may be rather too abbreviated for the beginner. The diagrams are, however, very necessary as there is no indication on the PCB of where to position the components. PCBs often have silk screen overlays which show the positions each numbered component will occupy — there is no such guidance in this kit so it is a case of using the diagrams to work out which drilled holes relate to each resistor, capacitor, etc. This is just a niggling criticism but I found that it was rather misleading to have a diagramatic instruction suggesting that I prepare my soldering iron right at the beginning when in actual fact the instructions meant me to place in position all the resistors and the IC and then solder all of them to the PCB in one goand, similarly, then to posdition all the other components before doing the rest of the soldering.

The diagrams included in the remainder of the instructions were also very clear. The instructions suggest you use a quick-drying glue for securing the LED holder in position. I used "Superglue" which fastened it immediately. I would advise using "Superglue" — but be careful you position it exactly as there can be no second chances!

I was pleased to note that the instructions advise you to check that the probe is working before putting the circuit into its case. Details of an appropriate test are given and as long as you've followed the assembly instructions you should experience no trouble. If you do not get the response described, however, a useful troubleshooting chart is included, listing the most common problems and their remedies.

I found the final assembly the most difficult part of building this kit. The problem is withouble. If you do not get the response describe, however, a useful troubleshooting chart is included, listing the most common problems and their remedies.

I found the final assembly the most difficult part of building this kit. The problem is with getting the three LEDs into their holes. This needs a combination of firmness and gentleness. You need to be patient at this stage or you may ruin your work.

Even though I found this stage tricky, the whole assembly took well under an hour and I would imagine that even a novice circuit builder could complete the kit in about an hour.

The manual includes two pages about testing the digital logic probe without explaining why these tests — a threshold test and a pulse test — are required. The short answer is that they are not really necessary. They check the calibration on the probe but if the probe works then it is reasonable to consider that it is working to specification. So if you do not have the equipment needed (a 5 volt regulated power supply, a digital voltmeter and a linear potentiometer) then do not fret — just assume your probe is properly calibrated UNLESS IT GIVES YOU STRANGE RESULTS! For example, take a circuit you know about and which you are confident is working properly and see if the probe gives you the signals you'd expect. If at any stage of the testing you find the probe is faulty and you cannot put it right then return it to GSC at their address in Essex. Whether or not a charge is made for the repair will depend on whether the fault was caused by your incorrect assembly of the kit or a defective part being supplied originally.

The booklet explains how the probe is used and gives a chart to help interpret the signals emitted. However, there is actually a lot more to know about the use of your logic probe — and this will be dealt with next month.

Conclusion

This is an attractively presented kit which is suitable for the inexperienced kit builder, though the absolute beginner would need some additional instructions. Balancing out time against cost, the LPK-1, seems to offer a worthwhile saving over comparable ready built logic probes. However, before you rush out to buy one consider the applications you wish to use your probe for and decide whether a pulse width of 300 nanoseconds is sufficiently accurate. If this sounds like excessively complicated advice, be sure to buy next month's Electronics and Computing for the second part — How to Use a Logic Probe.

C.A.D.

Continued from Page 28

here will save a fair amount of memory space. The array covers the elements of a series of matrices, without the use of which the calculation of networks would be hopelessly clumsy and wasteful of memory space. More will be said about this use when the logic of computation employed is covered in future articles.

For convenience of reference this set of programs has been christened 'LADNET' because it has been designed to deal with the family called ladder-networks. The typical ladder network is a series of impedances arranged as a four terminal circuit in which one input and one output are strapped together, and usually taken to ground, while the other two are joined by a number of element in series interspersed with others shunting various locations along the chain to ground. This is a common form of electrical wave-filter, the other common form consisting of two series arms balanced to ground, and shunted by elements between similar points in the two arms. This form, the balanced ladder network, can be dealt with by this program over the

Typical Ladder Network.

frequency range only in which it is truly balanced to earth.

A two active armed network, in which the two points joined by shunt elements are not located at similar points in the two arms, is called lattice type, and is not covered by this program. One type, not a true ladder, but so frequently used, and amenable to the methods used here, is covered, and is usually called a 'tee filter'. Two further forms, frequently used in conjunction with ladder networks, the transformer and the transistor driver are also covered, although the use of the 'active' net destroys the two-way symmetry normally associated with purely passive sections.

A diagrammatic ladder network is shown in the figure, and where the number of sections might well exceed ten, the amount of memory required to deal with it as a whole, would be excessive. This problem is overcome in the present proposal by storing only the values of the components, evaluating progressively along the net, so that only the intermediate values of one section have to be stored, and also tackling only one frequency at a time. For the final output therefore only the overall transmission over the chosen frequency range has to be stored at the steps chosen, but the intermediate results can be automatically output n the printer before they pass from memory. This ability to output many sets of intermediate values on printer by a suitable setting of a debug variable index at any stage of running, allows valuable flexibility in locating unsuspected faults in local configurations.

It also allows an initial run to be made at small range of log-spaced frequencies on the initial scan, and then to enter a much smaller range of closely spaced frequencies on the initial scan, and then to enter a much smaller range of closely spaced frequencies in a region where more detailed view is desired of a rapidly changing characteristic. ■

ELECTRONICS & COMPUTING MONTHLY insurance bureau

Money, money, money!

There's never quite enough of it, is there? Especially at this time of year, with the aftermath of Christmas spending to contend with, coupled with heavy quarterly bills. Furthermore it is the season of glossy holiday brochures, beckoning you on to spend even more money you haven't got!

This month I thought we might take a look at personal finances, particularly relating to borrowing money.

The problems of getting it — and then repaying it

It seems to me that there are two problems. Firstly, getting hold of the cash one needs. You may have in mind a home extension, replacement windows, double glazing or even a new car for the Spring. The second problem is coping with the level of repayments that build up. Not only is there the mortgage, but also H.P., Bank loans, second mortgages and those credit card repayments! The gradual increase of these monthly outgoings can become a worrying burden.

But what really is the problem?

I believe that the real problem is the build up of **short term** borrowings. Most of the sources of finance mentioned above require repayment in two years or less. Wouldn't it be much better to spread them over a much longer period?

Remortgages

You may well reply that this is surely easier said than done. But there is a way that is worth investigating. Most people who have owned a house for a few years have now built up substantial equity in the property. Houses worth £30,000 very often have a mortgage of only £5,000 to £10,000 outstanding to the Building Society. The idea of a remortgage is to approach another Building Society for a completely new FIRST mortgage on your house. We are **not** talking about a second mortgage in addition to your present Building Society loan. We call this process remortgaging the property.

How to do the sums

The way to go about it is to add up all your present borrowings. The example below illustrates this process. You may well find that you have loans of various sorts that tot up to £5,000. You then add this total to your present Building Society loan, which might be another £5,000, and then seek a new mortgage for the whole £10,000! Out of this figure you pay off the present Building Society and all the other loans. You then have only one debt and one monthly payment.

Type of Borrowing	Amount (£)	Payments (£)
BEFORE		
Building Society Mortgage	5,000	65
Car H.P.	2,000	100
Credit Cards	500	50
Second mortgage	1,500	45
Bank Loan	1,000	50
	10,000	310
AFTERWARDS		
Building Society mortgage	10,000	145

Reduced outgoings

All E.C.M. readers are numerate people, I am sure! So everyone will have noticed the dramatic reduction in outgoings. Some will correctly argue that they have now committed themselves to these repayments for 25 years. This is quite true. But think about the impact of inflation on your original mortgage. Surely it makes sense to spread your repayments over as long as possible, reduce your outgoings now and so increase your spendable income TODAY!

Remortgages available now

Obviously this idea will not appeal to everyone. It will also not be available to everyone for various reasons relating to each individuals personal circumstances. If, however, you believe reorganizing your repayments would be helpful, or you have some major item of expenditure in mind where a remortgage might apply, then take a look at the idea.

Remortgages are available from some Societies at present. Whether you get one depends on the facts of the case and how they are presented. You can approach your insurance advisor who may be able to guide you. If you wish to complete the coupon below and mail it to us, we will pass it on to a sister organization of ours that specializes in this area.

I hope that this article will help you to have a financially more comfortable 1982!

Name .... Age ....
Address ....
...... Day Tel. No. .... Home Tel. No. ....
Value of house (est) .... Age of house ....
Present B/Soc loan ... Total other loans O/s ....
Total monthly repayments (including B/Soc) ....
Mail to: ECM Insurance Bureau, 18 Hamilton Road, Nottingham NG5 1AU.

Mini/Venture Program

```
100 POKE 11,0: POKE 12, 253: GOSUB 8000: SP=53259: YP=14: XP=25:
PP=SP+YP*64+XP
105 D1=53916: D2=53668: D3=53932: KE=57088: IN=0
110 M=0: SP(0)=53711: SP(2)=53278: SP(2)=53741
115 B(0)=10: B(1)=100:
120 DEF FNR(X)=INT (RND (1)*(X+1))
125 DEF FNA(X)=SP(X)+64*(FNR(4)+1)+FNR(11)+1
130 PRINT CHR$(12): POKE 53325,32: GOSUB 9000: SP=53259
135 S=53325: M$="ENERGY": GOSUB 1500: S=53362: M$="SPELLS":
GOSUB 1500
140 S=53389: M$="GOLD": GOSUB 1500: S=53426: M$="THINGS":
GOSUB 1500
145 GOSUB 3500
150 FOR I=0 TO 2: RC(I)=FNR(10): NEXT
155 B(1)=B(1)-B(2)/100: GOSUB 3520: IF B(1)<1 THEN 1020
160 POKE 530,1: POKE KE,127: A=PEEK(KE): POKE 530,0: X=XP: Y=YP
165 IF A=127 THEN Y=Y-1
170 IF A=191 THEN Y=Y+1
175 IF A=223 THEN X=X-1
180 IF A=239 THEN X=X+1
185 IF A=247 AND M THEN GOSUB 6000
190 IF M THEN GOSUB 5000
195 Z=SP+Y*64+X: ZZ=PEEK(Z)
200 IF ZZ=32 THEN GOTO 235
205 IF ZZ=96 AND(IN) THEN IN=0: GOTO 235
210 IF ZZ=96 AND IN=0 THEN IN= -1: GOSUB 7000: GOTO 235
215 IF ZZ=4 THEN B(2)=B(2)+GL: GOSUB 3500: GOTO 235
220 IF ZZ=182 THEN B(1)=B(1)+EL: GOSUB 3500: GOTO 235
225 IF ZZ=245 THEN B(0)=B(0)+SL: GOSUB 3500: GOTO 235
230 GOTO 255
235 POKE PP, 32: XP=P: YP=P: PP=SP+64*YP+XP: POKE PP,240
240 IF PEEK(D1)=32 THEN POKE D1,96
245 IF PEEK(D2)=32 THEN POKE D2,96
250 IF PEEK(D3)=32 THEN POKE D3,96
255 IF M THEN 150
260 IF FNR(100)<1 THEN M= -1: EU=FNR(60)+1: XM=25: YM=12
265 GOTO 150


1000 FOR I=1 TO 240: POKE PP,I: NEXT: IF FNR(10)<3 THEN CT=CT+1:
GOTO 1000
1005 B(1)=B(1)-EU: IF B(1)>1 THEN 1035
1010 POKE PP, 32: IF CT<=2 THEN M$=". . . IT GOT YOU . . .": GOSUB 3000
1015 IF CT>2 THEN M$=". . . AFTER A GREAT BATTLE - IT GOT YOU . . ."
GOSUB 3000
1020 FOR X=1 TO 2000: NEXT: MS$=STR$(INT(B(3)+B(2)/100)):
GOSUB 3500
1025 M$=". . . YOUR FINAL SCORE IS"+MS$+"POINTS . . .": GOSUB 3000
1030 PRINT: PRINT: PRINT: END
1035 MC=0: CT=0: B(3)=B(3)+1: GOSUB 3500: POKE MP,32: M=0: RETURN
1500 FOR I=1 TO LEN(M$): POKE S+I, ASC(MID$(M$,I,1)): NEXT: RETURN


3000 FOR I=54219 TO 54269: POKE I,10: NEXT: L=LEN(M$)
3005 FOR I= 1 TO L: POKE(54244-L/2)+I, ASC(MID$(M$,I,1)): NEXT:
RETURN


3500 FOR I=54219 TO 54269: POKE I,10: NEXT
3505 M$=STR$(B(2))+" ": S=53396: GOSUB 1500
3510 M$=STR$(B(3))+" ": S=53432: GOSUB 1500
3515 M$=STR$(B(0))+" ": S=53368: GOSUB 1500
3520 M$=STR$(INT (B(1)))+" ": S=53332: GOSUB 1500
3525 RETURN


5000 MC=MC+1: MP=SP+64*YM+XM: IF MC>100 THEN M=0: MC=0:
POKE MP,32: RETURN
5005 U=XM: V=YM: XX=INT(SGN(XP-XM)*FNR(SK)+.5)
5010 YY=INT (SGN(YP-YM)*FNR(SK)+.5)
5010 IF XX=1 THEN U=U+1: GOTO 5035
5020 IF XX= -1 THEN U=U-1: GOTO 5035
5025 IF YY=1 THEN V=V+1: GOTO 5035
5030 IF YY= -1 THEN V=V-1
5035 POKE MP,32: W=SP+64*V+U: WW=PEEK(W)
5040 IF WW=32 OR WW=96 THEN XM=U: YM=V: GOTO 5055
5045 IF WW=240 THEN 1000
5050 RETURN
5055 MP=SP+64*YM+XM: IF EU>=80 THEN POKE MP,252: RETURN
5060 IF EU<80 AND EU>30 THEN POKE MP,181: RETURN
5065 POKE MP,243: RETURN


600 IF B(0)>0 THEN 6010
6005 M$=". . . YOU DONT SEEM TO HAVE ANY . . .": GOSUB 3000: RETURN
6010 B0)=B(0)-1: IF ABS(YM-YP)<3 AND ABS (XM-XP)<6 THEN 6020
6015 M$=". . . MISSED . . .": GOSUB 3500: RETURN
6020 B1=PEEK(MP-64): B2=PEEK(MP+64): B3=PEEK(MP-1):
B4=PEEK(MP+1)
6025 FOR S=100 TO PEEK(MP): POKE MP,S: POKE MP+64,S: POKE MP-64,S
6030 POKE MP+1,S: POKE MP-1,S: NEXT
6035 POKE MP-64,B1: POKE MP+64,B2: POKE MP-1,B3: POKE MP+1,B4
6040 HP=FNR(30): EU=EU-HP: IF EU>1 THEN RETURN
6045 POKE MP,32: M=0: MC=0: EU=0: B(3)=B(3)+1: GOSUB 3500: RETURN


7000 IF Z=D1 THEN T=0
7005 IF Z=D2 THEN T=1
7010 IF Z=D3 THEN T=2
7015 IF RC(T)=0 THEN RETURN
7020 ON RC(T) GOTO 7025, 7030, 7035, 7040, 7045, 7050, 7055, 7060,
7065, 7070
7025 GOSUB 7075: RETURN
7030 GOSUB 7090: RETURN
7035 GOSUB 7080: RETURN
7040 GOSUB 7085: RETURN
7045 GOSUB 7090: GOSUB 7075: RETURN
7050 GOSUB 7090: GOSUB 7080: RETURN
7055 GOSUB 7090: GOSUB 7085: RETURN
7060 GOSUB 7090: GOSUB 7075: GOSUB 7080: RETURN
7065 GOSUB 7090: GOSUB 7075: GOSUB 7085: RETURN
7070 GOSUB 7090: GOSUB 7080: GOSUB 7085: RETURN
7075 EL=FNR(50)*FNR(2)+1: FP=FNA(T): POKE FP,182: RETURN
7080 SL=FNR(5)+1: SE+FNA(T): POKE SE,245: RETURN
7085 GL=FNR(50)*FNR(2)+1: GP=FNA(T): POKE GP,4: RETURN
7090 IF M THEN RETURN
7095 EU=FNR(50)*FNR(2)+1: Y1=INT((SP(T)-SP)/64): M= -1
7100 YM=Y1+FNR(4)+1: XM+(SP(T)-SP)-Y1*64+FNR(11)+1: RETURN


8000 M$=CHR$(12): GOSUB 8150
8005 M$="DO YOU WANT INSTRUCTIONS?": GOSUB 8150: X=USR(X)
8010 IF PEEK(531)<>89 THEN 8060
8015 M$=CHR$(12): GOSUB 8150
8020 FOR I=1 TO 15: READ M$: GOSUB 8150: NEXT
8025 POKE 54221,32: X=USR(X)
8030 M$=CHR$(12): GOSUB 8150
8035 FOR I=1 TO 10: READ M$: GOSUB 1850: NEXT
8040 M$="TREASURE -"+CHR$(4): GOSUB 8150
8045 M$="FOOD -"+CHR$(182): GOSUB 8150
8050 M$="SPELLS -"+CHR$(245): GOSUB 8150
8055 M$="THINGS -"+CHR$(243)+","+CHR$(181)+","+CHR$(252):
GOSUB 8150
8060 M$="DO YOU WISH AN E-EASY OT H-HARD GAME?": GOSUB 8150
8065 X=USR(X): IF PEEK(531)=69 THEN SK=2: RETURN
8070 IF PEEK(531)=72 THEN SK=1: RETURN
8075 GOTO 8065


8150 PRINT TAB(24-LEN(M$)/2)M$: RETURN


8500 DATA MINI VENTURE, " "
8050 DATA The object of this game is to survive!
8510 DATA " ", You are trapped in a maze of caves that are
8515 DATA inhabited by THINGS! The caves also contain
8520 DATA TREASURE and FOOD, as well as SPELLS which are
8525 DATA quite effective against the things. Fighting
8530 DATA and carrying the gold drain your energy -
8535 DATA so collect as much food as possible.
8540 DATA " ", To collect the food etc move your man onto it, " "
8545 DATA " ", Press any key to continue
8550 DATA The following keys are used to move around -
8555 DATA " ", 1 - to move up, 2 - to move down, 3- to move left
8560 DATA 4 - to move right, " ", Press 5 to spell blast the 'things'
8565 DATA " ", "The following symbols are used -"


9000 FOR I=0 TO 2: FOR J=0 TO 12: POKE SP(I)+J,128:
POKE SP(I)+J+384,135: NEXT
9005 FOR K=SP(I)+63 TO SP(I)+321 STEP64: POKE K,143:
POKE K+14,136: NEXT K,I
9010 FOR I+53729 TO 54241 STEP64: POKE I,143: POKE I+6,136
9015 IF I=53921 OR (I+6)=53927 THEN POKE I,32: POKE I+6,32
9020 NEXT
9025 SP=53853: FOR I=0 TO 3: POKE SP+I,128: POKE SP+11+I,128:
POKE SP+128+I,135
9030 POKE SP+139+I,135: NEXT
9035 S=210: POKE 53671,S: POKE 53991,S: POKE 53980,S
9040 S=209: POKE 53852,S: POKE 53863,S
9045 S=208: POKE 53857,S: POKE 53868,S
9050 S=207: POKE 53665,S: POKE 53996,S: POKE 53985,S
9055 S=96: POKE D1,S: POKE D2,S: POKE D3,S
9060 S=161: POKE D2-1,S: POKE D2+1,S: POKE D2-2,S: POKE D2+2,S
9065 S+10: POKE 53740,S: POKE 53724,S: POKE 53675,S: POKE 53661,S
9070 RETURN
```

HOME BUSINESS PROGRAM

by John Higgins

ASSIGNMENTS FOR 'DIM' STATEMENTS

DIM		A(31)
A(1)	–	Input for options
A(2)	–	B.S. savings balance
A(3)	–	B.S. interest rate
A(4)	–	B.S. monthly payment
A(5)	–	B.S. Withdrawals
A(6)	–	B.S. Monthly interest
A(7)	–	B.S. Total interest
A(8)	–	B.S. Total Withdrawals
A(9)	–	B.S. Total payments
A(10)		Bank-Bal
A(11)		Expenditure
A(12)		Salary
A(13)		Ins Payment
A(14)		Total expenditure (month)
A(15)		Total Pay
A(16)		B/F from 1981
A(17)		Total (B/F + Total pay)
A(18)		Expenditure
A(19)		Monthly-Bal
A(20)		Current-Bal
A(21)		Total ins payments
A(22)		Total Bal.
A(23)		Remainder Spare
		DIM B(10)
B(1)		Month number (for B.S. program)
B(2)		Year number
B(3)		Previous year number
B(4)		Month number (Bal. sheet)
B(5)		Etc. Spare

FOR ZX81 16K
HERE IS A VERY USEFUL PROGRAM, THAT KEEPS A DETAILED RECORD OF YOUR BANK BALANCE ,EXPENDITURE, BUILDING SOCIETY SAVINGS AND WILL ALSO GIVE A MONTHLY/ANNUAL BALANCE SHEET OR RESULTS AS AND WHEN REQUIRED.

DIM STATEMENTS ARE USED AND THE LENGTH OF ARRAY CAN BE ADJUSTED TO SUIT INDIVIDUAL NEEDS. ONCE THE PROGRAM HAS BEEN PUT INTO MEMORY ,FOR THE FIRST TIME, THE COMMAND 'RUN' SHOULD BE USED TO RESERVE THE AREAS OF MEMORY FOR DIM STATEMENTS.HOWEVER ONCE DATA HAS BEEN LOADED,USE GOTO 35 TO AVOID SETTING ALL DATA TO ZERO.
THE INDEX IS PRESENTED,AND NUMBERS 1 TO 7 CAN NOW BE INPUT TO REACH DESIRED SECTION OF PROGRAM.

BUILDING SOCIETY
SELECTED FROM 1 OR 5.
1- ALLOWS WITHDRAWAL AMOUNTS WITHOUT CALCULATION OF INTEREST.
5-RESULTS SHOWN OR PROGRAM MAY BE RUN AFTER RESULTS.

PROGRAM RUN.
THIS WILL:- SHOW MONTH NUMBER, CALCULATE INTEREST OF BALANCE, AND ADD TO BALANCE,ALSO TOTAL INTEREST.
WHEN MONTH NUMBER SHOWS 2 OR 8, THE TOTAL INTEREST IS RESET TO ZERO,THIS IS TO FOLLOW BUILDING SOCIETY PAYOUT,WHICH OCCURS TWICE YEARLY.
ANY DEPOSITS ARE TAKEN CARE OF FROM BANK BALANCE PROGRAM.
THIS PROGRAM IS ONLY INTENDED TO BE RUN ONCE MONTHLY EITHER AS ABOVE IF NO DEPOSIT IS TO BE MADE,OR FROM BANK BALANCE PROGRAM.
INTEREST RATE IS IN PROGRAM AND IS CALCULATED AT 10.5 PER CENT.

BALANCE SHEET
SELECTED FROM 3 OR 7.
7-RESULTS ONLY.
3-RUNS PROGRAM-SHOWS MONTH NO. TOTAL SALARY,TOTAL EXPENDITURE ETC.
AFTER THE TWELTH MONTH,YEAR NUMBERS ARE INCREASED BY ONE, AND TOTAL C/F NOW BECOMES TOTAL B/F FROM PREVIOUS YEAR.MONTH NUMBER REMAINS AT ZERO FOR RESULTS BUT REVERTS TO ONE IF PROGRAM IS RUN.

EACH TIME PROGRAM IS RUN, MONTHLY EXPENDITURE IN BANK BAL PROGRAM IS RESET TO ZERO READY FOR THE NEXT MONTH.
THE PROGRAM IS INTENDED TO BE RUN ONCE MONTHLY,ALTHOUGH RESULTS CAN BE SEEN ANYTIME.

BANK BALANCE
SELECTED FROM 2 OR 6.
2-RUNS PROGRAM,ALLOWS INPUTS FOR EXPENDITURE,SALARY,BUILDING SOCIETY PAYMENTS,AND INSRANCE.
IF B.S.PAYMENT IS MADE A JUMP OCCURS TO B.S.PROGRAM AND BACK TO BANK BALANCE PROGRAM.
PROGRAM IS RUN AS AND WHEN REQUIRED.
6-RESULTS ONLY.

```
          INDEX
CHOOSE PROGRAM REQUIRED

       1  [illegible]
       2  [illegible]
       3  [illegible]
       4  [illegible]

     FOR RESULTS ONLY

       5 HBS
       6 BANK BAL
       7 BAL SHEET

      [illegible]1982
MONTH NUMBER 1
TOTAL B/F FROM1981=2360.24
TOTAL PAY=970
TOTAL=3330.24
TOTAL EXP=222.32
MONTHLY BAL=747.68
CURRENT BAL=3107.92
      [illegible]     1705.04
                      837.37644
                      553
                      3193.4164
SELECT OPTION REQUIRED
       1  RERUN PROGRAM
       2  RETURN TO INDEX

      [illegible]1982
MONTH NUMBER 12
TOTAL B/F FROM1981=2360.24
TOTAL PAY=970
TOTAL=3330.24
TOTAL EXP=222.32
MONTHLY BAL=970
CURRENT BAL=3107.92
      [illegible]     1705.04
                      837.37644
                      553
                      3193.4164
SELECT OPTION REQUIRED
       1  RERUN PROGRAM
       2  RETURN TO INDEX

      [illegible]1983
MONTH NUMBER 0
TOTAL B/F FROM1982=3193.4164
TOTAL PAY=0
TOTAL=0
TOTAL EXP=0
MONTHLY BAL=0
CURRENT BAL=0
      [illegible]     1705.04
                      837.37644
                      553
                      3193.4164
SELECT OPTION REQUIRED
       1  RERUN PROGRAM
       2  RETURN TO INDEX

      HBS
MONTH NUMBER 4
MONTHLY INT=8.2738117
TOTAL INT=16.475856
BAL=953.85229
TOTAL WITHDRAWALS=0
TOTAL PAYMENTS=800

SELECT OPTION REQUIRED
       1  [illegible]
       2  [illegible]

      [illegible]
BAL=1636.[illegible]
TOTAL EXP=67
TOTAL PAY=0

SELECT OPTION REQUIRED
       1  RERUN PROGRAM
       2  RETURN TO INDEX
```

```
  10 REM "HOME BUSINESS"
  20 DIM A(31)
  30 DIM B(10)
  35 CLS
  40 PRINT "HOME BUSINESS PROGRA
M"
  50 PRINT
  60 PRINT TAB 10;"INDEX"
  65 PRINT
  70 PRINT "CHOOSE PROGRAM REQUI
RED"
  80 PRINT
  90 PRINT TAB 8;"1 [illegible]"
 100 PRINT TAB 8;"2 [illegible]"
 110 PRINT TAB 8;"3 [illegible]"
 120 PRINT TAB 8;"4 [illegible]
[illegible]"
 130 PRINT
 140 PRINT TAB 7;"[illegible]
[illegible]"
 150 PRINT
 160 PRINT TAB 8;"5 HBS"
 170 PRINT TAB 8;"6 BANK BAL"
 180 PRINT TAB 8;"7 BAL SHEET"
 190 INPUT A(1)
 200 IF A(1)=1 THEN GOTO 270
 210 IF A(1)=2 THEN GOTO 700
 220 IF A(1)=3 THEN GOTO 1000
 230 IF A(1)=4 THEN GOTO 1270
 240 IF A(1)=5 THEN GOTO 525
 250 IF A(1)=6 THEN GOTO 875
 260 IF A(1)=7 THEN GOTO 1075
 270 CLS
 280 PRINT TAB 8;"HBS"
 290 PRINT "BAL=";A(2)
 300 PRINT "INPUT WITHDRAWALS"
 310 INPUT A(5)
 320 CLS
 330 LET A(2)=A(2)-A(5)
 340 LET A(8)=A(5)+A(8)
 345 PRINT TAB 8;"HBS"
 350 PRINT "BAL=";A(2)
 360 LET A(5)=0
 365 PRINT "SELECT OPTION REQUIR
ED"
 370 PRINT TAB 8;"1 [illegible]
[illegible]"
 390 PRINT TAB 8;"2 [illegible]
[illegible]"
 400 INPUT A(1)
 410 IF A(1)=1 THEN GOTO 270
 420 IF A(1)=2 THEN GOTO 35
 460 LET A(3)=.00875
 470 LET A(6)=A(2)*A(3)
 480 LET A(7)=A(6)+A(7)
 490 LET A(2)=A(2)+A(6)+A(4)
 495 LET B(1)=B(1)+1
 500 LET A(9)=A(4)+A(9)
 505 IF B(1)=2 OR B(1)=8 THEN LE
T A(7)=0
 515 IF B(1)=13 THEN LET B(1)=1
 520 IF A(4)>0 THEN GOTO 780
 525 CLS
 530 PRINT TAB 8;"HBS"
 535 PRINT "MONTH NUMBER ";B(1)
 540 PRINT "MONTHLY INT=",A(6)
 550 PRINT "TOTAL INT=";A(7)
 560 PRINT "BAL=";A(2)
 570 PRINT "TOTAL WITHDRAWALS=",
A(8)
 580 PRINT "TOTAL PAYMENTS=";A(9
)
 590 PRINT
 600 PRINT "SELECT OPTION REQUIR
ED"
 610 PRINT TAB 8,"1 [illegible]
[illegible]"
 620 PRINT TAB 8,"2 [illegible]
[illegible]"
 630 INPUT A(1)
 640 IF A(1)=1 THEN GOTO 470
 650 IF A(1)=2 THEN GOTO 35
 700 CLS
 710 PRINT TAB 8;"[illegible]"
 720 PRINT "BANK BAL=";A(10)
 730 PRINT "INPUT EXP"
 740 INPUT A(11)
 750 PRINT "INPUT HBS PAYMENT"
 760 INPUT A(4)
 770 IF A(4)>0 THEN GOTO 460
 780 PRINT "INPUT SALARY"
 790 INPUT A(12)
 800 PRINT "INPUT SUN"
 810 INPUT A(13)
 820 LET A(14)=A(14)+A(11)
 830 LET A(21)=A(21)+A(13)
 840 LET A(15)=A(15)+A(12)
 850 LET A(10)=A(10)-A(11)+A(12)
-A(4)-A(13)
 860 LET A(4)=0
 870 LET A(11)=0
 875 CLS
 880 PRINT TAB 8,"[illegible]"
 890 PRINT "BAL=";A(10)
 900 PRINT "TOTAL EXP=";A(14)
 910 PRINT "TOTAL PAY=";A(15)
 920 PRINT
```

continued on page 10

TECHNICAL GRAPH PLOTTING WITH THE ZX-81

by Reg Boor

The ZX-81 PLOT instruction is extremely convenient and saves having to write complex plotting routines. Nevertheless, in order to construct a technically useful graph some care has to be taken in drawing the graph paper and in scaling and placing the plot. Additionally, because of the size of an individual "pixel", there is a minimum useful computing interval which will avoid placing them on top of one another and so save computing time.

It is not suggested that the programs offered here are unique, just that they do the job neatly and form a basis, perhaps, for further enhancement using high resolution graphics. For now, however, it is assumed that the reader is content to use the keyboard facilities of his ZX-81.

I have chosen the plus sign with which to draw the graph paper. Any other symbol, or combination of symbols, seems cumbersome by comparison. The disadvantage, although easily overcome, is that a computed point cannot be plotted at a graticule intersection, because, as the ZX-81 handbook says, a screen element is divided up into four pixels "like a Battenburg cake". To recapitulate this particular point, the ZX-81 allows us the use of 704 T.V. screen elements each of which can display one keyboard character or four pixels. The graph paper program, lines 10 to 280, is given on figure 1. It is straightforward, merely a matter of establishing the graticule and leaving room for scales and titles. Traditionally these are around the edges of the graph and they are drawn so here, if you want a larger graph format there is nothing to prevent you drawing the graticule as large as the screen with the titles and scales inside it.

The program is given in open form, you will close it by entering your own titles in lines 210, 230, 250 and 280, and choosing values of X1 through X5 in line 190. Based on these X values you will also choose Y1, Y2 and Y3 on lines 150, 160 and 170. How this is done now follows.

We are going to plot computed values of the "dependent variable", Y, against the "independent" (or input) variable X, in mathematical terminology, Y is a function of X. This means that we choose a range of X over which we wish to examine the characteristics of Y, so we place X5 equal to the maximum value of X in the range of interest and estimate (or even calculate with our ZX-81!) the maximum value of Y over the range. We then give Y3 a value equal to, or higher than this maximum Y, noting that

Figure 1.

```
          MAIN TITLE

       SUBSIDIARY TITLE

  Y3++++++++++++++++++++++++++
    +    +    +    +    +    +
    +    +    +    +    +    +
    +    +    +    +    +    +
    +    +    +    +    +    +
  Y2++++++++++++++++++++++++++
    +    +    +    +    +    +
 Y  +    +    +    +    +    +
AXIS+    +    +    +    +    +
    +    +    +    +    +    +
  Y1++++++++++++++++++++++++++
    +    +    +    +    +    +
    +    +    +    +    +    +
    +    +    +    +    +    +
    +    +    +    +    +    +
   0++++++++++++++++++++++++++
    0    X1   X2   X3   X4   X5
              X AXIS
```

```
10 REM THE GRAPH PAPER
20 REM SET UP THE AXES
25 REM DRAW THE X AXES
30 FOR N=0 TO 15 STEP 5
40 FOR M=0 TO 25
50 PRINT AT 4+N,4+M;"+"
60 NEXT M
70 NEXT N
75 REM DRAW THE Y AXES
80 FOR N=0 TO 25 STEP 5
90 FOR M=0 TO 14
100 PRINT AT 4+M,4+N;"+"
110 NEXT M
120 NEXT N
130 REM Y AXIS SCALE
140 PRINT AT 19,3;"0"
150 PRINT AT 14,2;"Y1"
160 PRINT AT 9,2;"Y2"
170 PRINT AT 4,2;"Y3"
180 REM X AXIS SCALE
190 PRINT AT 20,4;"0";TAB 8;" X
1";TAB 13;" X2";TAB 18;" X3";TAB
 23;" X4";TAB 28;" X5"
200 REM MAIN TITLE
210 PRINT AT 0,10;"MAIN TITLE"
220 REM SUBSIDIARY TITLE
230 PRINT AT 2,7;"SUBSIDIARY TI
TLE"
240 REM Y AXIS TITLE
250 PRINT AT 11,0;" Y  "
260 PRINT AT 12,0;"AXIS"
270 REM X AXIS TITLE
280 PRINT AT 21,12;"  X AXIS"
```

if Y3 is divisible by 3 and X5 by 5, we get nice scales and can complete lines 150, 160, 170 and 190 easily.

The calculation and plotting program, lines 290 to 380, is a given on figure 2, once again in open form. You have chosen the values of X5 and Y3 to insert in lines 320, 330 and 340, according to the function under examination, which itself is placed in line 350. Lines 320 and 330 evaluate two scales, in pixels per unit, on which are based the minimum computing interval (STEP) and the first X value, line 340, which ensures that pixels are neither placed on top of each other, nor plotted at graticule intersections. These scales are also used in line 370 to position the plot on the graph paper.

A typical 'O' level quadratic function is plotted on figure 3 as an example, it is shown together with the line alterations required to do the computation. Note that the range of interest of X is zero to 0.5, so that 0.5 is the value of X5 and that the maximum value of Y is 15, so Y3 equals 15. These numbers are divisible by 5 and 3 respectively so we obtain easy to read scales. The program still draws a graph even if X5 and Y3 are not so divisible but the scales would be difficult to read from and even to write on the graph paper!

A more elaborate example is shown in figure 4, on which are plotted the drag coefficients of three model aircraft with differing wing planforms, as characterised by their aspect ratios. The technicalities of this problem do not concern us here but the basic equation is in line 350, as previously, and you will see that there are two inputs to it, the lift coefficient, CL and the aspect ratio A. To tackle this we use two FOR NEXT loops, the outer one controls aspect ratio and does not need the scales SX and SY, the inner loop controls the X variable, which is now lift coefficient, or CL, and it works exactly like the previous example. Note also the two lines 390 and 400, inside the outer loop, which identify each of the three curves by printing the aspect ratio on the graph.

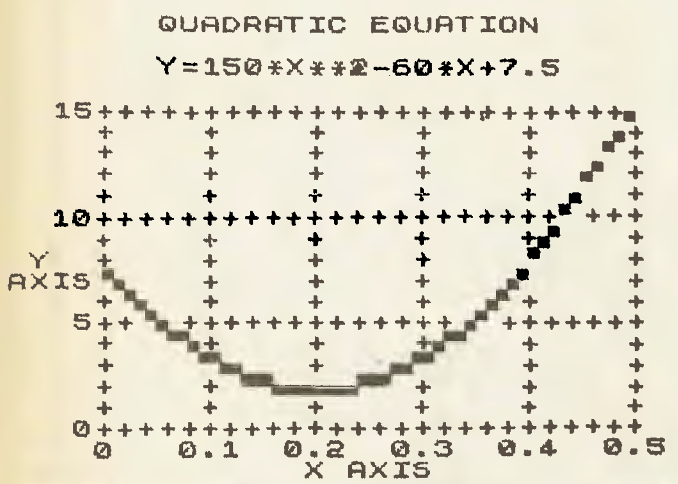
It is not necessary to plot at every possible pixel location, you can arrange to plot fewer points by modifying the end of line 340, after STEP. By inserting 2/SX, for instance, half as many points are plotted. Take care, by the way, to differentiate between the letters S and the figures 5 in this part of the program.

Finally, although the pixel is rather a blunt instrument with which to draw graphs, it is certainly adequate to illustrate the main characteristics of mathematical functions and, although the program given is constructed only to draw graphs in the positive quadrant (i.e. both X and Y positive throughout the range) it is hoped that the user who requires it will unravel the system of scaling and placing the plot, so as to allow him to illustrate any function. To have described this in detail would have made the article very complicated, whereas the recipe given for plotting positive functions works with ease.

Figure 2.

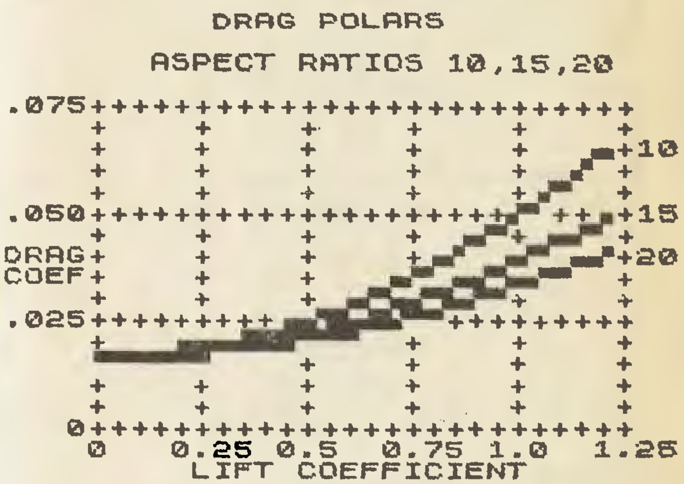
```
290 REM CALCULATE Y=FUNCTION(X)
320 LET SX=50/X5
330 LET SY=30/Y3
340 FOR X=1/(2*SX) TO X5 STEP 1
/SX
350 LET Y=FUNCTION X
360 REM PLOT THE RESULTS
370 PLOT 8+SX*X,5+SY*Y
380 NEXT X
```

Figure 3.




```
150 PRINT AT 14,2;" 5".
160 PRINT AT 9,2;"10"
170 PRINT AT 4,2;"15"
180 REM X AXIS SCALE
190 PRINT AT 20,4;"0";TAB 8;"0.
1 ";TAB 13;"0.2";TAB 18;"0.3";TA
B 23;"0.4 ";TAB 28;"0.5 "
200 REM MAIN TITLE
210 PRINT AT 0,7;"QUADRATIC EQU
ATION"
220 REM SUBSIDIARY TITLE
230 PRINT AT 2,7;"Y=150*X**2-60
*X+7.5"
320 LET SX=50/0.5
330 LET SY=30/15
340 FOR X=1/(2*SX) TO 0.5 STEP
1/SX
350 LET Y=150*X**2-60*X+7.5
```

Figure 4.




```
290 REM CALCULATE Y=FUNCTION(X)
295 FAST
320 LET SX=50/1.25
330 LET SY=30/0.075
335 FOR A=10 TO 20 STEP 5
340 FOR X=1/(2*SX) TO 1.25 STEP
1/SX
345 LET CL=X
350 LET CD=0.015+CL**2/(PI*A)
360 REM PLOT THE RESULTS
370 PLOT 8+SX*CL,5+SY*CD
380 NEXT X
390 LET A$="A"
400 PRINT TAB 30;VAL A$
410 NEXT A
420 SLOW
```

Just talking shop

Computers on the Altar in California.

Under the headline, "Why should the Devil have all the best micro's"? It was recently announced that **Church Computer Systems Inc.** of Sunnydale (Honest! no Kidding), California is now installing modular packaged systems, based upon the Vector Graphic computer, into churches in California.

Software includes, packages for Bible instruction, sermons, membership and attendance records, together with an accounts system for the collections, givings and disbursements. There is also a free magazine based on floppy disc to keep everyone in touch.

It sounds like a good idea, which of course could only have come from California, but I can't help having a laugh. Imagine the computer, housed alongside the altar (with perhaps a terminal in the confessional box) monitoring the transgressions of the flock, tailoring the sermon accordingly and recording its impact by the size of the following collection (the way they do things in California, thats not so far fetched as you might think).

But why should the computer stop there? With a bit of development and perhaps the addition of voice synthesis that magazine, based on floppy disc could actually contain the sermon. Originating on Mount Siniai (or more likely, Beverly Hills!), and descending each week to the gathered congregation, it could even take on the image of a holy tablet putting terror into the flock, and of course recording the appropriate response. (Which this being California, and it being a computer, it does by counting the hard cash in the till at the end of the day). Pretty soon that holy Vector would be the main communication channel to the Almighty, through which all supplications would be passed. Yes Sir, for a genuine, guaranteed reply within 24 hours.

Nippon Gakki enters Micro Market.

Yet another well known Japanese company has entered the microcomputer market. Nippon Gakki, well known in the West for its Yamaha brand of electronic organs, guitars and other musical instruments, has just launched an integrated home entertainments system based around its own microcomputer. Called the Yamaha Integrated System it comprises, the computer and a range of optional modules which currently include, a video disc player, an automatic piano, a musical keyboard and a range of electronic musical instruments. Available at the moment only on the Japanese market the computer retails at $4,400 (about £2,200) and the piano player at $1,500. You can be sure they will launch it onto the western markets when they think we can afford these prices.

It seems we will soon be able to compose and conduct a full, simulated, symphony orchestra without getting out of the armchair. I dread to think waht would happen if every house in the street got one. Brahms from those nice folk at number one. Martial music from those dreadful people who have just moved in to number 12. Welsh choral music from the Evan's at number 6, and if that horrible little schoolgirl up the other end does not get her full ensemble of recorders playing Greensleeves right soon I'll go mad.

30 Million Sales Forecast.

The latest survey of the market for personal computers in Japan, produced for a large Japanese microcomputer company, forecasts sales of 30 million systems into Japanese homes and businesses by the end of this decade. 30 million! That's one for every 3 Japanese. With such a large and prosperous home market it makes me wonder why they bother with us improverished Westerners.

If there's anyone left who still thinks that half the population lives on a bowl of rice a day they'd get one hell of a shock if he/she visited Japan today.

Low cost Floppies.

Good news for home based disc drive systems. American pioneer of floppies, Shugart, is reportedly preparing a low cost 5.25 inch mini floppy drive for launch within the next few weeks.

It will be assembled by Matshushita in Japan and is based on the popular SA200 drive.

Quantity prices are estimated to be as low as $90 per unit which means they could appear on the UK market at no more than twice this price.

Tandy TRS 88

Tandy are expected to take the wraps off their top secret 16 bit micro any day now. Called the TRS88 it is based on the highly rated M68000 processor chip and should cause quite a stir at the lower end of the micro business. It might even enable Tandy to fend off the strong pressure from Sharp for the number two position in the European market (Commodore is still tops), but not if they live up to form and fail to deliver until the end of the year.

Sharp-Rockwell Contract.

Finally, just to twist the knife in, it has recently been announced that Rockwell Corporation have signed a technology agreement with Sharp of Japan under which Sharp will license Rockwell to use its CMOS low power chip technology. Rockwell employees will be quality control procedures.

The contract comes just 10 years after Sharp signed a similar deal with Rockwell whereby the American company would train Sharp employees in the art of manufaturing its micro circuits. QED.

Time Travel

Readers who followed the serious articles on time travel in the July and August issues of E&CM will be interested to learn that the British Interplanetary Society, which numbers amongst its members some very eminent physicists and astonomers, has produced a design for a proton powered rocket which is theoretically capable of gradually accelerating to 600 million miles per hour, and more, thus enabling astronauts to benefit from time dilation effects in order to be able to reach distant stars.

One of the expeditions listed for future explorers is indeed to Barnard's star, as mentioned in the first article. The proton-powered rocket is envisaged to be erected in earth orbit and to consist of enormous sails, many miles across, which are used to capture protons in the universal cosmic radiation. These are concentrated into a beam of high energy particles which are then used to provide a constant accelerating force to the huge ungainly looking structure. Over a period of many months the space ship will reach these incredible speeds, and time as measured by the astronauts will slow down to a fraction of that on earth.

Clearly, we do not have the technology to build such a machine yet, but it may well come sooner than the 200 years mentioned in Roger Davies's articles.

Good news for Bubble memory.

A major boost for bubble memory technology has just been received from of all people, British Telecom. They have come to the conclusion that bubbles win out over discs in terms of reliability, performance and maintenance costs.

With their high reputation for specifying only the top grade products, British Telecoms announcement will do much to enhance the image of bubble technology after the denting it took last year when in quick succession Texas Instruments, National Semiconductor and Rockwell all announced they were pulling out of that market.

Plessey Microsystems have designed the bubble memory boards for eventual incorporation in the System X digital telephone exchange we are so patiently waiting for. There will be 18 bubble memory boards in each system X unit and each board has a 1 mega-byte memory built up from 256K elements supplied by Motorola. Plessey intend to switch over as soon as possible to 1 Megabit elements also supplied by Motorola, with Hitachi acting as second source.

This further re-enforces my prediction made last October, at the time TI etc were pulling out, that bubble memories will finally replace floppy discs by the end of this decade.

UPDATE

Continued from Page 31.

KITS. Including printed circuit boards and assembly instructions.

Name	Price inc.VAT (pounds)	Memory size (000)	Power Supply Inc.	Case Inc.	Keyboard Inc.	Display Inc.
SinclairZX-81	50	1	no	yes	yes	no
Atom	140	2	no	yes	yes	no
Microtan 65	80	1	no	no	yes	no
Tuscan	270	8	yes	yes	yes	no
Nascom	419	16	yes	no	yes	no
Power-Tran	258	3	yes	yes	yes	no
Compukit	205	4	yes	no	yes	no

Professional Quality Imported Models.

(Note. Printer is not included unless indicated).

Name	Model No.	origin	CPU	Memory (RAM)	DOS	Disc Drive.	Bus	Price (pounds)
Altos	ACS8000	USA	Z80	208K	CP/M	Winnie	own	8,195(23)
Al-Micro	ABC26	JAP	Z80	64	CP/M	2x5"	own	3,195
Alphatronic	P2	GER	8085	48	own	5 "	own	1,500
Apple.	II	USA	6502	64	own	5 "	SS50	3,000
Aristocrat.		USA	Z80	180	CP/M	2x5"	S100	4,000
Commodore	Pet II	USA	6502	48	own	5 "	SS50	3,500
Compucorp	655	USA	Z80	64	CP/M	5 "	IEEE	
Cromemco	2	USA	Z80	64	own	5 "	S100	
DataGeneral	Enterprise	USA			own	2x5"	own	$7,195(1)
DMS inc.	DSC4	USA	Z80	512	CP/M	8 "	S100	3,995
Fujitsu	Micro8	JAP	6809	64	UCSD	2x5"	own	$2,375
Gnat	10		Z80	64	CP/M	5 "	S100	3,000
Heath	Z89	USA	Z80	64	CP/M		S100	1,500
HewletPackard	HP85	USA	8085	32	own	5 "	IEEE	1,935
HewletPackard	HP125	USA	Z80	64	CP/M	2x5"	own	4,372(1)
Hitachi	MB6809	JAP	6809	32	own		own	1,330
IBM	Sys23	USA	---		own	2x8"	own	$9,835(1)
Kontron		GER	Z80	64	KOS	Winnie	own	(2)
NEC	PC8000	JAP	Z80	64	CP/M	2x5"	own	2,000
North Star	Horizon	USA	Z80	56	CP/M	2x5"	S100	4,000
OhioChallenger	3	USA	Z80	48	CP/M	8 "	own	1,500
Oki	800	JAP	Z80	64	CP/M	2x5	own	4,299(1)
Osborne	I	USA	Z80	64	CP/M	2x5"	own	1,500
Panasonic	JD700U	JAP	8085	56	own	8 "	own	4,000
Pasca	640	JAP	Z80	64	CP/M	2x8"	own	3,300
Sharp	PC3200	JAP	Z80	64	CP/M	2x5"	own	3,500
Superbrain.		USA	Z80	64	CP/M	5 "	S100	1,900
Sord	M223	JAP	Z80	64	CP/M	8 "	S100	4,000
Tandy	ModII	USA	Z80	64	CP/M	8 "	own	2,300
Tandy	ModIII	USA	Z80	48	TRSDOS	2x5"	own	1,799
Toshiba	T-200	JAP	8085	64	CP/M	2x5	own	3,000
VectorGraphic	5005	USA	Z80	64	CP/M	Winnie	S100	5,399(23)
VectorGraphic	2600	USA	Z80	64	CP/M	2x5"	S100	3,345
Xerox	Worm	USA	Z80	64	CP/M	2x5"	own	$3,000

(1) Includes matrix printer.
(2) Includes Winchester hard disc plus floppy back-up.
(3) Multi-user, Multi-tasking capability.

Building BASIC

• Mike James continues his series designed to assist electronics enthusiasts write their own computer programmes in Basic.

Part Six
By Mike James

Logic

This month we examine logic. Many people believe that computers and computer programmers spend all of their time dealing with logic. If you've been following the series you'll know that this is far from the truth. To write programs in BASIC, or any other computer language, does not require any understanding of traditional logic. For the subject of digital electronics however things are very different. The design of any digital equipment requires at least an intuitive understanding of logic. BASIC can help with digital electronics because it can evaluate logical expressions the same way it can evaluate arithmetic expressions.

After learning about logic in BASIC it is easy to find many other uses for it apart from helping with digital design — so while programming can help with electronics the practice helps the programming!

Boolean logic

There are many different types of logic but the one that concerns us here is one of the simplest — Boolean logic. Boolean logic is based on the simple fact that a statement is either true or false. We may actually not know if a particular statement is true or false but for boolean logic to work all that matters is that it must be one or the other i.e. true or false are the only possibilities. If this seems obvious to you then don't worry too much because it is!

Consider the BASIC statement A > 0. Does this say "the variable A IS greater than zero"? Suppose A is to set equal to one earlier in the program then A>0 is true, but if we set A equal to minus one then A>0 is false. It should be clear now that A > 0 doesn't mean that we are saying A IS greater than zero but it is a statement which may be true or false. A statement which may be true or false is known as a **Boolean expression**. You may be wondering where you could use an expression like A>0 well the answer should be obvious:

```
10 IF A>0 THEN PRINT "A IS BIGGER THAN ZERO"
```

We have been using boolean expressions all the time within IF statements. The general form of the IF statement can now be expressed as

```
IF boolean expression is true THEN statement
```

The boolean expressions that we already know are all based on the relational operators introduced when we dealt with the IF statement. To recap:

=	equals	A = B
<	smaller	A < B
>	greater	A > B
<>	not equal	A <> B
<=	smaller or equal	A <= B
>=	greater or equal	A >= B

Our new understanding of these means that each is a statement which may either be true or false. Notice that the sign "=" has two meanings in BASIC. It can be used to mean signment i.e. LET A=0 or it can be used as a relational operator i.e. IF A=0 THEN etc. In the first case A IS set equal to 0 and in the second A is unchanged and instead a true or false result is returned. Also remember that the relational operators can be used to compare strings as well as numbers — see BB part 4.

Boolean operators

So far boolean expressions have given us nothing but a reinterpretation of old facts. If this was all there was to Logic it would hardly be worth the bother!

Consider the following short program:

```
10 PRINT "INPUT TWO RESISTANCE VALUES";
20 INPUT R
30 INPUT S
40 IF R < 0 THEN PRINT "RESISTANCE MUST BE
   BIGGER THAN ZERO!"
50 IF S < 0 THEN PRINT "RESISTANCE MUST BE
   BIGGER THAN ZERO!"
      rest of program
```

At lines 40 and 50 we test to see if the two resistance values are smaller than zero. If you examine these two lines carefully you might think that there is some repetition because the same thing happens if either resistor is less than zero and if both are less than zero the message is printed twice. As a simple exercise the reader might like to try to change the program to print the message just once no matter what. From a common sense point of view it would be nice if we could write in place of lines 40 and 50:

```
40 IF R < 0 OR S < 0 THEN PRINT "RESISTANCE
   MUST BE BIGGER THAN ZERO"
```

The part of the statement between the IF and the THEN is still a boolean expression, that is it can either be true or false. To see that this is the case we can examine what makes the IF statement carry out the statement following the THEN.

R<0	S<	THEN taken
False	False	No
False	True	Yes
True	False	Yes
True	True	Yes

By examining the above table it should be clear that the THEN course of action is taken if either of the two inequalities is true and this is of course what we mean by OR! Going back to the definition of the IF statement the boolean expression R < 0 OR S < 0 must be true if the statement following the THEN is carried out. We can now write the earlier table as:

R<0	S<0	R<0 OR S<0
False	False	False
False	True	True
True	False	True
True	True	True

This is called a truth table and it is one of the basic ways of understanding logic expressions. Apart from understanding a logic table we have also discovered our first logical operator — OR. It is worth pausing for a moment to think about the similarities between what we have just done and the more familiar evaluation of arithmetic expressions. In arithmetic we write A + B and everyone understands that for various values of A and B we could work out the result of A + B. We could write down an "arithmetic table" listing all the values that A and B could have and the result A+B. This would take rather a long time however as that number of values that A and B can take on is infinite! (i.e. 0, 1, 2, 3, 4, 5.. even if we only want to work with whole numbers.) In case of logical expressions we don't have the same trouble as each variable can only take on two values — true or false — and we can write the truth table for A OR B very easily.

Logical variables

At the end of the last section we introduced a new idea that deserves further mention. Going back to our analogy with arithmetic, the two values, true and false, are logical constants in the same way 0, 1, 2, 3, 4, ... etc are arithmetic constants. It would be nice if BASIC provided us with logical variables that we could set equal to logical constants e.g.

```
10 A = TRUE
20 IF A THEN PRINT "A TRUE"
```

You may find the above program difficult to read and it may look a little strange, but you should be able to understand what it's getting at. The variable A is a logical variable, it can only store the values true/false, and at line 10 it is set equal to the constant true. At line 20 the IF statement evaluates the boolean expression A and finds that it is true so the THEN is taken.

The trouble is that most BASICs do not have logical variables so this explanation is not exactly correct. It is however correct in spirit as we shall see. Although the two values that a boolean expression can take on are usually called true and false, these names are entirely arbitrary. We could call them "plink" and "plonk" or anything else without altering boolean logic at all. More to the point we could call them 0 and 1 and use ordinary arithmetic variables to hold logical values! This is the method used by most BASICs. The only extra complication is that not everyone can agree on 0 and 1 and some use 0 and -1 or -1 and +1 etc, etc. The differences are irritating but not too important. A brief summary of how the different BASICs handle Boolean logic can be seen in table one.

(The "full evaluation range" column will be explained later.) For the rest of the article we will assume that 1 is true and 0 is false. With this decided our earlier program becomes.

```
10 A = 1 20 IF A THEN PRINT "A TRUE"
```

It is now possible for us to use the computer to produce the truth table for OR.

```
10 FOR I = 0 TO 1
20 FOR J = 0 TO 1
30 PRINT I;" ";J" ";I OR J
40 NEXT J
50 NEXT I
```

Logical Operators

We arrived at our first logical operator — OR by appealing to common sense. It would be possible to continue to apply common sense and derive the other often-used logical operators, but to save time and avoid tedium the following BASIC program will print truth tables for OR, AND and NOT:

```
10 PRINT "TRUTH TABLE FOR AND-OR-NOT"
20 FOR I = 0 TO 1
30 FOR J = 0 TO 1
40 PRINT I;" ";J;" ";I AND J;" ";I OR J;" ";NOT I
50 NEXT J
60 NEXT I
```

AND used between two logical variables will result in the expression being true only if both variables are true. NOT is a unary operate (see BB part one) and simply changes the truth value of a single variable into the other value — i.e. NOT changes true into false and false into true. We have already dealt with OR. These three basic logical operators are all we need to express any boolean logic. At a more practical level AND, OR and NOT are all we need to express any set of conditions for an IF to carry out the statement following the THEN.

Logical operators can be combined into expressions in much the same way as arithmetic operators. The only thing you have to be careful of is the priority of the operators (see BB part 1) most BASICs define the priorities so that, unless you use brackets, NOT is done first then AND and finally OR. For example NOT(I) AND I, NOT(A < 0) AND (B < 0), (A = 0) OR (A = 1) AND (B = 0)) are all valid logical expressions. The rules for manipulating such expressions are not difficult to learn and if you're interested there are many good books on simple logic that will help you become proficient in manipulating logic. For the purposes of programming, however, becoming an expert logician is more than we require — the computer can always work any difficult logic out for us! For example if you need to know the truth table for NOT(I) AND I then change line 40 in the previous program to:

```
40 PRINT I;" ";J;" ";NOT(I) AND I
```

If you're lucky enough to own a ZX81 or use a version of BASIC that has a full VAL or EVALuate instruction, try changing the previous program by:

```
10 INPUT A$
40 PRINT I;" ";J;" ";VAL(A$)
```

This will allow you to type in ANY logical expression of I and J and print out its truth table because the function VAL works out the expression contained by the string A$. If you want to work out a truth table with three variables all you have to do is add a FOR loop with a variable K and so on for four variable, five . . . until you run out of memory or patience.

Simplifying Expressions

There is one thing that a computer cannot do very easily for you and that is to simplify boolean expressions. Sometimes while working out what should go inside an IF

BASIC	True	False	range
Microsoft V5	0	-1	-32768 to 32767
ZX81	1	0	see below
APPLE	1	0	-
ATOM	1	0	-65536 to 65535

BASIC	True	False	range
Microsoft V5	0	-1	-32768 to 32767
ZX81	1	0	see below
APPLE	1	0	-
ATOM	1	0	-65536 to 65535

statement you might come up with something like:

```
10 IF NOT (A < 0) THEN ....
```

You might have said to yourself, "If A isn't smaller than zero then . . ." and translated "isn't smaller than zero into BASIC as NOT (A < 0). There is nothing wrong with this method of constructing IF statements — it's the way we ALL do it — but if you've been programming for a while you notice that NOT (A < 0) is the same thing as A >= 0. Put into words "A isn't smaller than zero" is the same thing as "A is bigger or equal to zero". By making this simple change you can make the program slightly simpler and faster to run. There are a whole host of such simplifications that you can make to a complex logical expression but it's up to you to decide if it's worth it. This is very similar to simplifying arithmetic expressions before using them in a program — it's not wrong to use A*B+A*C rather than A*(B+C) but the latter is faster. We all learn how to simplify arithmetic expressions at school but logical expressions are something else! Fortunately we are saved by the fact that in practice the logical expressions that crop up are fairly simple and can be altered by using some common sense.

Some rules for manipulating boolean expression might be useful however:

Relations

1. NOT(A=B) = A<>B
2. NOT(A<B) = A>=B
3. NOT(A>B) = A=<B

Logic

1. NOT (NOT (A)) = A
2. A OR (B AND C) = (A OR B) AND (A OR C)
3. A AND (B OR C) = (A AND B) OR (A AND C)
4. NOT (A OR B) = NOT (A) AND NOT (B)

The rules for relations are easy enough to understand but the logic ones might be less obvious. The first logic rule says that to NOT something twice leaves it unchanged. The second and third rules are easier to understand if you compare it to arithmetic — A*(B+C)=(A*B)+(A*B) — both AND and OR can be factorised just like multiplication. The final rule is the most difficult and it is known as De Morgan's law. It is important because it provides the link between AND and OR in that any expression involving OR can be changed into one involving AND and vice versa. This isn't a complete list of rules for manipulating logic but it will see you through most logical problems.

The other logical operators

AND, OR and NOT are all the logical operators that you NEED but sometimes it is useful to give names to often used combinations of them. Moreover, Not many BASICs offer you more than AND,OR and NOT so it is important for you to know how to make up these more complicated operators.

NOT (A OR B) = A NOR B
NOT (A AND B) = A NAND B
(NOT (A) AND B) OR (A AND NOT(B)) = A EOR B

The first two examples are easy, the third, EOR looks impossible! In fact EOR — exclusive OR — is one of the most useful logical operators. To find out what it does a truth table helps —

A	B	A EOR B
0	0	0
1	0	1
0	1	1
1	1	0

Looking at the last column you should be able to see a similarity with the truth table produced by OR. The difference is that EOR is true (i.e. 1) only when one of A or B is true and OR is true if one or both are true.

Electronics and logic

At the start of this article it was explained that logic is used in the design (and debugging) of digital circuitry. In this section I will try to explain the connection between programming and hardware logic.

Digital circuits are built up from a range of integrated circuits which provide elementary logic functions. For example in the 74 range the 7400 contains four NAND gates. These provide the same operation as our NOT (A AND B) expression did in the last section, except that instead of 0 and 1 representing true and false two voltage levels (5V and 0V) are used and A and B are two inputs to the circuit. So if we have a network of simple logic integrated circuits we can write down a boolean expression to represent them and use a program, based on the one given earlier, to work out a truth table and hence what outputs you get for any input. This is of course much easier than building the circuit.

This idea of translating a piece of simple digital electronics to a boolean expression is the basis of a very powerful technique that can be used to try out any digital design. The reason why we have to extend the method is that most even slightly advanced digital equipment goes beyond "static" logic by using oscillators and pulse generators to "run" the logic circuits. So far we have not introduced a way of generating such pulses, or clocks as they are often called, but it's not too difficult and would make a very interesting project for the reader to tackle.

Evaluation Range

This section is a little more advanced than the rest of the article so you may want to skip it until some later time. What happens if you try something like:

```
10 A=6
20 B=7
30 PRINT A AND B
```

So far we have only discussed logical operations involving values like 0 and 1. What happens if you try ANDing numbers like 6 and 7 depends on the version of BASIC that you are using. Some will treat the numbers as binary numbers e.g. 6=110 and 7 = 111 and carry out the logical operation on each pair of bits in turn e.g. bit one of 6 is 0 and bit one of 7 is 1 so the result of ANDing them together is 0 and so on with the second and third pairs of bits giving 110 as the answer. The result of this bitwise logical operation can of course be treated as another binary number and converted back to decimal e.g. 110 is 6. Any BASIC that works this way will have a largest number that it can deal with and this is listed in the table given earlier under the heading of "full evaluation range".

The ZX81 is very special in its use of logical operations on extended ranges (i.e. other than 0 and 1). If you try:

```
10 PRINT A AND B
```

you will find that if B is 0 the result is zero but if B is anything else the result is A. This remarkable feature also works for strings.

```
10 PRINT A$ AND B
```

will print nothing (i.e. the null string) if B is zero and A$ if B is any other value. This is particularly useful if you're trying to fit a program into a 1K ZX81 because instead of

```
10 IF B<>0 THEN PRINT A$
```

you can use

```
10 PRINT A$ AND B
```

The other logical operators on the ZX81 are also special — A OR B is A if B is 0 and 1 if B is anything else, NOT A is 0 if A is not zero and 1 if it is. Neither of these can be used with strings but they are very powerful statements and deserve further study, however this comes under the heading of "very clever programming"!

Conclusion

We have introduced the topic of boolean logic in programming at a fairly simple level (apart from the last section) and you will probably be relieved to hear that it's at the simple level that it's most often used. Using ANDs and ORs should make your programs easier to read and smaller but do take care to check that the logical expressions that you use mean exactly what you want. Logic can sometimes be confusing!

Next month:

More advanced BASIC.

BOOK SHOP

1. ELECTRONICS QUESTIONS & ANSWERS £1.95

2. VIDEO QUESTIONS & ANSWERS £1.95

3. INTEGRATED CIRCUITS £1.95

4. INTRODUCTION TO MICROCOMPUTER PROGRAMMING £3.75

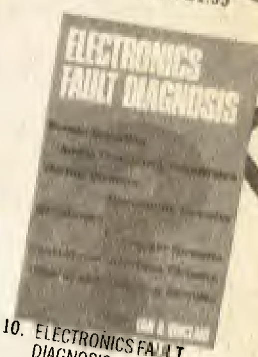
5. COMPUTER SCIENCE . £3.95

6. GUIDE TO PRINTED CIRCUITS £3.50

7. THE CATHODE-RAY OSCILLOSCOPE AND ITS USE £3.95

8. HOW TO BUILD ELECTRONIC KITS £2.95

9. INTRODUCING ELECTRONIC SYSTEMS £2.95



10. ELECTRONICS FAULT DIAGNOSIS £3:50

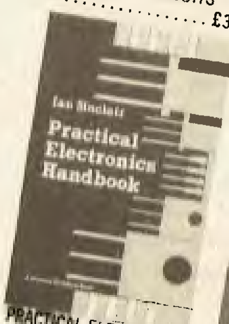
11. REPAIRING POCKET TRANSISTOR RADIOS . £2.95

12. ELECTRONIC COMPONENTS £4.50

13. AMATEUR ELECTRONICS £3.50

14. BEGINNER'S GUIDE TO INTEGRATED CIRCUITS £3.25

15. ELECTRONIC TEST EQUIPMENT PROJECTS £2.95



16. PRACTICAL ELECTRONICS HANDBOOK £3.00

17. TELETEX AND VIEWDATA £5.50

18. MICROPROCESSORS FOR HOBBYISTS £2.95

19. INTRODUCING MICROPROCESSORS . £0.00

Please supply the following books

TITLE ....

....

TITLE ....

....

TITLE ....

....

TITLE ....

....

TITLE ....

BOOK SHOP

FREEPOST (no postage stamp necessary)
ELECTRONICS & COMPUTING MONTHLY
67a HIGH STREET
DAVENTRY NORTHANTS

I enclose cheque/PO for £ ....

or debit credit card Access No. ....

(Please add £1.00 to cover P & P regardless of number of books)

Name ....

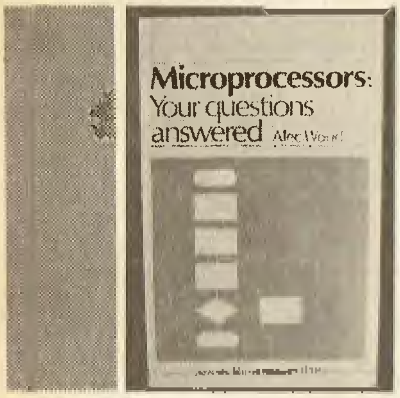
ADDRESS ....

....

My emphasis this month is on practical issues and getting a better understanding of electronics – either through some very sound explanation or through actually building circuits yourself. I also include a children's book suitable for enquiring young minds.

Microprocessors: Your Questions Answered

by Alec Wood, 155 pages, £4.95
Published by Newnes Technical Books, 1982.

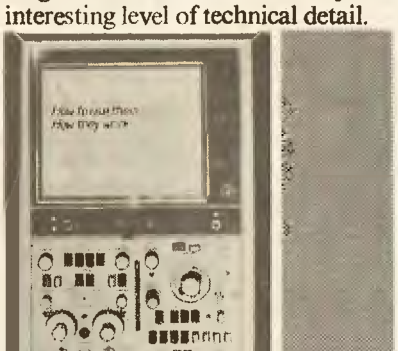


I was very pleased to find a book which approaches the subject of micros in such a straightforward and comprehensible way. Alec Wood "has set out to dispel the mystique that surrounds the microprocessor" and he has actually suceeded rather well. The book starts off by explaining what microprocessor chips are and explains the different types of logic used. This is done with the aid of diagrams that the electronics enthusiast will find easy to understand. The second chapter, about hardware, shows how the different microprocessors are related to one another and introduces other parts of the system that so often remain as lightly dismissed jargon terms which have you wondering which technology they are referring to, such as bus and port! The next chapter deals with software which explains how high level language, such as BASIC, is converted into assembly language, hexadecimal code and machine code. I found the explanations given of machine code and hexadecimal very clear. The chapter on logic explains the logic gates with the help of neatly presented diagrams. The next three chapters cover aspects of computation, there is then a chapter devoted to memory, one to control (covering interrupts and the clock) and one to input and output (dealing with communication with the external world). The final chapter is about further programming techniques and it's still easy to follow! This book has clear presentation throughout and once you've read it from cover to cover you need never be bewildered by microprocessors again.

Oscilloscopes

by Ian Hickman, 122 pages, £3.45
Published by Newnes Technical Books, 1981.

An oscilloscope is a fairly expensive piece of test equipment but a lucky enthusiast may have access to one — at work, at school or through a friend and some will even buy their own. And of course lots of people have a professional interest in scopes. This book will be of interest to anyone who may ever want to buy or just operate a cathode-ray oscilloscope. It is of course possible to use scopes for years without ever understanding the principles by which they operate, but Hickman's book will make the subject more interesting and allow you to make the most of their features. In the first chapter the basic principle of "oscillography", that of displaying a voltage that is varying using two-dimensional, or co-ordinate, geometry, is explained. Chapter two introduces the "basic" oscilloscope, presenting its block diagram and explaining its controls. From here a jump is made to the advanced oscilloscope which is considered in chapter three in technical detail. The next chapter examines accessories — probes, cameras, calibrators and graticules — all fairly briefly. Chapter 5 is about using oscilloscopes and choosing the right equipment for your application — a topic covered further in the next chapter. Many examples of output waveforms are presented. The last part of the book is devoted to how the oscilloscope works. This book is illustrated throughout with photographs and diagrams and covers its subject at an interesting level of technical detail.



Counter Driver and Numerical Display Projects, 91 pages, 1980.
Electronic Timer Projects, 88 pages, 1981.

both by F G Rayer, £1.95
Published by Bernard Babani Ltd.

These books each present a collection of fairly traditional circuits all of which use tag board or point-to-point wiring on perforated board rather than PCBs. In the first one the methods of display covered are nixie tubes (neon), seven segment LEDs (solid state) and minitrons (filament). Rayer omits LCDs which are given no mention at all. The book explains well the principles involved but now that one can buy big chips that do in one the tasks that some of the circuits have been constructed for, it is likely to have limited appeal. However, for someone who wants to learn the fundamentals of drivers and displays or for someone who wants a cheap way of constructing a piece of equipment it is a good, attractively priced book.

When he deals with electronic timing circuits, Rayer presents a variety of simple circuits, some of which can be combined to give fairly complicated ones. LEDs for displays are used in many of the projects so if you've worked through the counter driver volume you'll be able to make use of your experience. The range of applications includes a car trip timer, an audio visual metronome and a darkroom timer.

Computers

by Brian Reffin Smith, 32 large pages, £1.85
Published by Usborne, 1981.

This is the first children's book on computers that I've looked at and I found it more fun than some of the other volumes I've been sent recently. For a start it has brightly coloured illustrations and has more pictures than text on every page. There are also puzzles, projects and games. Meanwhile it serves its purpose as an introduction to computers, the way they work, the way to give instructions to them and the variety of things a computer can do. "The Usborne Guide to Computers" book brings home to me the fact that the current generation of children are going to grow up taking microprocessors for granted. This book is suitable for youngsters from about age ten — but if they are your children make sure you read it first.

ZX81 SOFTWARE FROM VIDEO SOFTWARE LTD 1K & 16K

16K SOFTWARE

VIDEO-PLAN (ZX81 only). Performs the functions of an analysis book. Arithmetic functions include addition, subtraction, multiplication. Printer optional.

VIDEO-AD. Rotating display of 16 pages of advertising material. Set-up your own pages and change them as and when required.

VIDEO-GRAPH. Planning and design aid. Create pictures/charts/graphs and store within the program. Save on cassette. Combine pictures like an 'identikit'.

VIDEO-VIEW. Do it yourself teletext. Create pages of data. Store them within the program. Save on cassette. View on demand.

VIDEO-MAP. (ZX81 only). Educational game based on maps. Navigate your plane to its destination. Bomb the target and return to base.

FORCE-FIELD. (ZX81 only). Animated bombardment game. You control the force-field which protects your city against hostile UFOs.

SPACE-RACE. (ZX81 only). Party game for eight players. Rockets race to build stations in space. Winners gradually take over losers until only one winner remains.

FOOTBALL-LEAGUE. Realistic simulation of an entire season. Every match played and results shown with progressive league table. You give teams ratings for skill, effort, etc.

TEST-MATCH. Realistic simulation of a test match series. Dynamic scoreboard. Give each player your own ratings for skills, technique, etc.

STOCK-MARKET. (ZX81 only). An exciting game of skill and judgement. Buy and sell stocks and shares as prices change in response to world events.

PACK 1 — VIDEO-PLAN + VIDEO-AD.
PACK 2 — VIDEO-VIEW + VIDEO-GRAPH.
GAMESET — VIDEO-MAP + 5 GAMES.

1K PARTY TRICKS (ZX81 only) NEW! NEW!

If you don't have a 16K RAM this set of programs is for you. Ten separate programs — some games, some more serious. All completely original, all ten programs included in the price.

SHOOT	Take the penalty and watch the goalie try to save.
SKETCH	Draw an almost full screen picture and save on cassette.
NAME THE DAY	Give the date, the ZX81 names the day of the week.
TRAIN	For the very young who would like to drive a train.
ONGER-WONGER	Watch the ZX81 draw its own pictures and yours.
WEATHER	An endless variety of completely inaccurate weather forecasts.
UFO	Shoot down the UFO before he gets you.
WHO SHOT JR	An intriguing test of your powers of detection.
FIELD-GUN	Can you hit the target.
FOLLOW THAT	Follow the path traced by the ZX81.

NOTE: These programs are not suitable for ZX80.

NEW THIS MONTH

VIDEO-SKETCH (ZX81 16K only).
Move the cursor to any part of the screen. Draw or rub-out as you move it. Mix in text or graphics. Save picture in memory. Save picture sequence on cassette.
Std. @ £7.95. De-luxe @ £9.95.

NEWS FOR USERS

Those of you who have already voted with your cheque books may be interested in our 'top ten'. These are the best sellers so far:

1. VIDEO-VIEW
2. VIDEO-GRAPH
3. FORCE-FIELD
4. VIDEO-MAP
5. VIDEO-PLAN
6. FOOTBALL-LEAGUE
7. STOCK-MARKET
8. TEST-MATCH
9. SPACE-RACE
10. VIDEO-AD

Surprisingly some of the programs which we rate most highly are well down the list.

We expect our 1K programs to top this list soon. They are worth buying even if you have 16K.

PRICE LIST

ORDER CODE	*Manual*	*Std.*	*Lux*
SKETCH 81	—	7.95	9.95
PLAN 81	—	7.95	9.95
AD 81	—	7.95	9.95
GRAPH 81	—	5.95	7.95
VIEW 81	—	5.95	7.95
MAP 81	—	5.95	7.95
FORCE	—	3.95	5.95
SPACE	—	3.95	5.95
FOOT	—	3.95	5.95
TEST	—	3.95	5.95
STOCK	—	3.95	5.95
PARTY 1	1.95	4.95	6.95
PACK 1	—	—	17.95
PACK 2	—	—	13.95
GAMESET	—	—	19.95

Prices include VAT.
Mail order customers add £1.00 per order. (50p for manual only). Allow 28 days for delivery.
Std = cassette & manual. Lux = de luxe boxed sets.

STONE LANE,
KINVER,
STOURBRIDGE,
WEST MIDLANDS,
DY7 6EQ,
ENGLAND.

Tel: Kinver 2462
Std. 038-483-2462.

VIDEO
SOFTWARE LIMITED

Directors: P. Smith, B.A., D. J. Smith (*Director and Secretary*). Registered Number: 1085829 England. V.A.T. Reg. No. 278 0603 51

Personal callers welcome during office hours.
Send s.a.e. for further details.

ORDER FORM

Code	M/S/L	Qty.	Price	Total
P. & P.				

See above for codes

Your cheque no. ....

NAME ....
ADDRESS ....
....
....

ECM 3/82

ELECTRONICS & COMPUTING MONTHLY classified

FOR SALE

SURPLUS - EX EQUIPMENT 120W(60+60) "Power" amplifiers, case & controls, vol/bal, sockets, smoothing 5" heatsink boxed, dataflow soldered fibreglass, tested (RRP £25-80p) Simply return this Ad. + £9.95 (inc). Klifco 1 Regent Road Ilkley LS29 9EA. (illustrated leaflet S.A.E.).

48K SHARP MZ80K. Only 3 months old. Excellent condition. Complete with 55 games on tape (worth over £100). Total package, only £470 o.n.o. Phone 021 559 4602.

NEW C90 CASSETTES, low priced at only 35p each. Add 16p p/p or £1.50 for ten or more. J. Hudson, 6 Aysgarth, Great Hollands, Bracknell, Berks.

ZX81 with 16K as new £80. TR1 £5. Four Sinclair cassettes, two books £2 each. 5" B&W television £40. Tel: 01-668 8541.

XZ81 KEYBOARD SOUNDER, made from easily obtained components send £3 for instructions, P.C.B. and transducer or S.A.E. for details to R. Mitchell, 20 Gorse Close, Portslade, Sussex.

VIC-20 BLACK JACK. Play cards against your computer. Superb colour graphics. On cassette only £3.95. Arcadia Software, 4 Chestnut Avenue, Swansea SA3 5NL.

SEMITRON CRICKLATE LTD. offer a range of Zener, rectifier and avalanche diodes as surplus stock. Power rating 400MW to 25W. Each mixed packet has approximate retail value of £30 and is available at £5.50, including postage. All devices fully tested to original specifications. Orders above £20 value postage free. Cash with order please. Buy prime quality product direct from the manufacturer at a fraction of its true value. Semitron Cricklade Ltd., Dept. X1, Cricklade, Swindon, Wilts. Tel: 0793-751151.

ZX81 FLICKER-FREE GAMES. 6 super games plus FREE MENU, each 1K. All on cassette plus listing, £3. Bobker, 29 Chadderton Drive, Unsworth, Bury, Lancs.

TV TO SCOPE CONVERTER. Amazing easy built unit plugs into TV aerial socket to convert any TV into large screen oscilloscope. Cost of all components approx. £12. Circuit & Plans £3 (or S.A.E. details). J. Bobker, 29 Chadderton Drive, Unsworth, Bury, Lancs.

ZX81 SINCLAIR built perfect including power supply instruction book games tape. £55 01-883-3686. 141 Cranley Gdns. London W10 3AG.

UK101 EPROM PROGRAMMER as featured in January's E & C. Programs 2716 (+5v.) Eproms. Built, including Z.I.F. socket £29.50. Includes software on cassette. Please add £1 p&p to N.J.Tobin, 8 Kingsfield Road, Dane End, Nr, Ware, Herts.

NASCOM II — 32K RAM, stereo programmable synth, I/O board, programmable graphics, Eprom programmer, 6 slot mother board, assembler (zeap), basic. All in VDU case. Full documentation. Much Software. Guaranteed. £500 phone Matt Harvey on Dorking 880266.

AS IN SEPTEMBER E.C.M. MAINS WIRING TESTER KIT, £1. Transistor Tester Kit, £2. Please add 20p postage. Bobker, 29 Chadderton Drive, Unsworth, Bury, Lancs.

Send to:-
ECM CLASSIFIED, 67 HIGH STREET, DAVENTRY, TEL: 03272 71841

RATES
1-3 insertions £7 per scc
4-11 insertions £6.50 per scc
12 insertions £6 per scc
24p per word (min. 15 words)
Box No. on application
All advertisements in this section must be pre-paid.

CLOSING DATE
25th day of each month preceding publication date.

Advertisements are accepted subject to the terms and conditions printed on the advertisement rate card (available on request).

ACORN ATOM UTILITY ROM £29.90

The Willow Software 4K Utility ROM simply plugs into the spare utility ROM socket in your Atom and provides 18 powerful new commands and facilities including: Renumber, Range delete, Find, Auto line numbers, Program compression, Diassembler, True keyboard scanning, Memory dump, Variable dump, Register dump, Keyboard sounder, and much more. The Utilities make the Atom easier to use, and provide a 'toolkit' of facilities for program development in both Basic and Assembler. The ROM Utilities are professionally written and fully tested. All standard Atom facilities are unaffected and no textspace memory is used.

Due to increased demand, we are now able to offer the Utility ROM with full instruction manual at the reduced price of only £29.90 inclusive — post free. Send cheque/PO now for delivery by return of post, or write for further details. Official orders and Dealer enquiries welcome.

WILLOW SOFTWARE
PO BOX 6, CREDITON, DEVON EX17 1DL

Sharp MZ-80K disk system. Interface, controller and drives, all complete. BRAND NEW. £595 inc. VAT and carriage.

CWO please to:
Lowe Electronics, Chesterfield Road, Matlock, Derbyshire, DE4 5LE.

intro

MAESTRO turns your Video Genie/Tandy TRS80 or Pet 3020 (sound box required) into an impressive music synthesizer!
MAESTRO is not a toy or just another keyboard bleeper program, but a real musical instrument providing hours of fun for everyone.
Send only £9.50 for your copy of **MAESTRO.**
24 hour service. TRADE ENQUIRIES WELCOMED.
INTRO SOFTWARE LTD., 6 WOODBINE AVENUE, LEICESTER. Please state machine [illegible]

QWERTONIC

Musically logical keyboard, typewriter layout. Designed in 1882 by Janko, approved by **Liszt** and **Rubinstein.**
Send £1.00 for plans, post-free to **Mr. Roche, 71 Elmfield Avenue, Teddington, Middx. TW11 8BX.**

ARE YOU BORED WITH GAMES?

ZX81 16K Home Management Packages.
1. NAMES; Comprehensive address book.
2. BANK; No excuse for being overdrawn.
3. DATES; Never forget a birthday.
4. FREEZER; Checkout your freezer contents.
Any 2. £4.95 Cheques/Postal Orders Payable to:
CULWIN SOFTWARE
7 Penrith Close, Uxbridge Middlesex.

POOLS

Goal-average SCORE PREDICTION in 16K Program with 'FORM' and 'POSITION' weighting

Evaluates on relative goal scoring capability of competing teams. Resulting factor then weighted for division, home and away performance, current form and placing in division.

Program prints out 'Match Factor' for sequence listing and also predicts home and away team score.

Requires input of 10 figures from weekly published league tables, no stored data or updating needed.

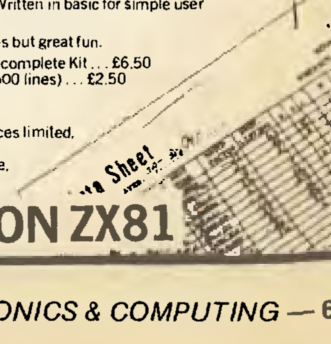
Program includes sequence listing routine, random selection option, calculator for No. of lines in perms and cost.

Supplied complete with data sheets for season also booklet of instruction, information and factor explanation. Written in basic for simple user adjustment.

No Guarantees but great fun.

Cassette with complete Kit . . . £6.50
Listing only (500 lines) . . . £2.50
(with s.a.e.$

c.w.o. to:-
Willden Services limited,
Maybank,
Yew Tree Lane,
Rotherfield,
East Sussex.



ON ZX81

ZX81 TAX

PAYE (81/82) for 1K ZX81
You pay too much tax then you need someone to tell you how much tax payable & refund due to you. This Program does just that.
Only **£3.95** (Cassette/Listing)
Only **£1.75** (Listing only)
Cheques/P.O.s to T.S. Arunasalam, 51, Downshire Hill, Hampstead, London NW3 1PA

Futura Software
nascom-2

Graphical Games Programs		
Star Wars*	32K	£10.00
Astrafire	16K	£5.50
Beam Me Up Scotty	16K	£5.00
Computer Darts	8K	£4.50
Downhill Skiar	8K	£3.50
Grand Prix	8K	£5.00
X-Wing Star Battle	16K	£6.50
Alien Bombardment	8K	£4.00
Speedway	8K	£5.00
Laser Duel	8K	£4.00
Martian Crossfire	8K	£3.60
Dodgams*	8K	£4.50

All programs are supplied on cassette and require Basic & Graphics. Prices are inclusive. SAE for details. Send Cheque or P.O. to: FUTURA SOFTWARE 63 Lady Lana, Chelmsford, Essex CM2 0TQ

* = New Program

ZX81 16K RAM

Cassette Games to Test Your Skill and Tactics

NASTY INVADERS £4.95
Get them before your bosses get you!
NASTY MOUNTAIN £4.95
VERY NASTY MOUNTAIN £6.95
Adventures on your way through the Mountain. If thats too easy, try the Very Nasty Game with its 16 Levels of Play.

- user program test facility
- prices include VAT and P&P

Cheques/P.O.s to:
Giltrole Ltd., Dept EC, P.O. Box 50, Rugby, Warks. CV21 4DH

ZX81 SOFTWARE

EIGHT 1K ANIMATED GAMES including "Defender", "Starwars", cassette £3.95 or listings £1.20 + S.A.E. Also 16K cassette including "Midnight Park", "Grandprix" £3.95. APY(Software), 33 Kings Copse Road, Hedge End, Southampton.

ZX81 16K/ZX80 4K. Full screen Graphics Games. Fruit Machine. Find The Lady. Craps. Galactic Duel. Compulsively interesting, many features and everything on screen. Excellent value at £5.00 per cassette/listings. State which — Towers. 16, Oatland Road, Little London, Leeds 7.

ZX81 16K: QUEST — Action adventure. Supermind - a version of Mastermind. Star Trek - The classic game. Reverse - arrange the digits. All on one cassette. No rubbish. Only £5.95. K.Stone 7 Woodside Road, Bickley, Kent.

ZX81 DATA provides read, data and restore statements (integral data values only). £1 listing, £2.50 cassette. Dccupies 191 bytes. A.N.Wilson, The Vicarage, Whitworth Square, Rochdale, Lancs. OL12 8PY.

ZX81 16K ADVENTURE GAME, on cassette, stretches the memory to the limit. £3 Simpson Software 21 Tuttles Lane West, Wymondham, Norfolk.

16K ZX81 SUPER INVADERS. Machine code sophistication. 54 manoeuvring aliens, saucers, defence bases, on-screen scoring. Dn cassette with graphic HANGMAN and SWAT. £3.50. G.J.Prince, 29 Brook Avenue, Levenshulme, Manchester, M19.

ZX 81 GAMES PACK Six 1K games. Includes Mad Driver, Alien, Elevate. Only £2.95. P. Webster, 66 The Avenue, London. M0 2QL.

DARTS CLOCK, Lissajou Snooker, Dog's Cricket, Torpedo, Grand National, Airship, Octopus, ICBM, Wipe Out. 12 games for ZX81 1K RAM. Cassette £3.90 incl. p & p. P. Sykes, 110 Church Lane, Goldington, Bedford MK41 0AS.

ZX81 1K MATHS EDUCATION programs: Ratio, Fractions, Functions, Tables, Estimate. Each at two levels, plus Simon, Sentences. Cassette £3.25. Math-Ed, 20 Wandle Road, London SW17.

ZX81 GAMES

HIGH QUALITY,
LOW COST SOFTWARE
(ABSOLUTELY NO RUBBISH)

GAMESTAPE 1, for 1K, only £3.95
10 Games incl. Asteroids, UFO, etc.

GAMESTAPE 2, for 16K, only £4.95
Starfighter, Pyramid, Artist.

GAMESTAPE 3, for 16K, only £5.95
Catacombs ... A Graphics Adventure.

GAMESTAPE 4, for 16K, only £5.95
3D Monster Maze ... Unbelievable Graphics

Cheque/P.O.s to J.K. GREYE SOFTWARE, 16 PARK ST., BATH, AVON BA1 2TE.

"SCOMPROGS"

ZX 81 SPACE PACK 10 great 1K adventures including space pilot, alien attack, invaders and voyages return + 16K invaders from £2.69.

ZX 81 GAMES COMPENDIUM, top selling pack of 20 shooting, driving, word/card games all 1K and amazing value at just £2.99.

1 CLOCHBAR AVE., MILNGAVIE. G62 7JW.

(sae for details) (Canada $9/item)

WANTED

QUALITY PROGRAMS for ZX81 and ATOM wanted. Send S.A.E. for details to P. Bambridge, 56 Ashford Crescent, Enfield, Middx. 30% Royalties.

URGENTLY REQUIRED BACK ISSUES of Electronics & Computing Nov. and Sept. 1981. Any reasonable price paid. Tel. Lowick Bridge 201.

2716 EPROM PROGRAMMER OR DIAGRAM, and machine code program. System 15 6800 based, and 6821 PIA. Can anybody Help! Help! Tel:(0734) 789014.

ZX81

Software Wanted
30% Royalties Paid

Send brief details to:
PSS, 112 Oliver St., Coventry.

ATOM SOFTWARE

TURTLE TALK — A new language for Atom. Ideal for children and newcomers to programming. Teaches structure of design, and geometry also! Needs 12K RAM and F.P. ROM. £18 for Eprom, cassette and documentation, or S.A.E. for details. M.J. Baker 5 Edinburgh Road, Hanwell, London W7 3JY.

TI99/4 ASSISTANCE

ADVICE, LISTS, DEBUGS, BESPOKE PROGRAMS FOR TI99/4. For details send S.A.E. Stephen Shaw, 10 Alstone Road, Stockport, Cheshire SK4 5AH.

Electronics & Computing Monthly

CLASSIFIED COUPON

SPECIAL OFFER TO PRIVATE ADVERTISERS

First 10 words free - then 24p per word (subject to minimum total of 20 words, i.e. minimum cost of £2.40).

Please print block capitals - one word per box		SECTION HEADING			
FREE	FREE	FREE	FREE	FREE	FREE
FREE	FREE	FREE	FREE		

Please insert this advertisement in the following editions of Electronics and Computing Monthly

Name............................

Address.........................

....

Tel: ....

P.O. Cheque No. ....

Cheques payable to

ELECTRONICS AND COMPUTING MONTHLY 67 HIGH STREET DAVENTRY NORTHANTS.

Signed ....

FIRST 10 WORDS **FREE** PLUS.......WORDS at 24p per word........ | NUMBER OF INSERTIONS ..... | TOTAL........

INDEX TO ADVERTISERS

Albol Electronics	24
Algray	57
Black Star Ltd.	35
Comp Shop	72
Computer Keyboards	53
Computer Services	12
Computer Shack Ltd.	50
Computer Supermarket	IFC
Control Technology	24
Croydon Micros	12/24
Discom	35
Dk'tronics	40
EDA Sparkrite Ltd.	IBC
Emprise Computers	53
Fuller Micro Systems	66
Gills	35
G.S.C. (UK) Ltd.	49
Hilderbay Ltd.	71
JSP	45
Micro Business Systems	12
Micro-Print Ltd.	66
Micro-Spares	8
Micro Style	60
Microvitec Ltd.	10
Midwich	47
MS	12
Program Power	53
Sharp Electronics (UK) Ltd.	OBC
Silica Shop	29
Silicon Centre	66
Sinclair Research Ltd.	4/5
Storkrose Ltd.	32
Tangerine	1
Thurnall (Electronic) Eng.	71
Video Software Ltd.	68
Watford Electronics	16/17

Sharp bring you the MZ80B. A machine that offers you functions previously only associated with more powerful, more expensive computers; that gives you versatility to handle a huge range of software and hardware applications in scientific, business and personal use.

The MZ80B opens up a new world of graphic display potential, more flexible data storage and retrieval, and ease of operation.

Here is the computer from the future. Available today.

Stunning Graphic Display.

Seeing is believing. The large-screen, high-focus, green-face display incorporated in the MZ80B gives you high-resolution graphics of 320 x 200 dots.

An additional graphic RAM can be added which allows another 320 x 200 dot resolution pattern to be displayed.

This dual high-resolution graphic ability is especially useful for simulating and displaying a dynamic picture. It can display 40 characters x 25 lines or 80 characters x 25 lines via software switching.

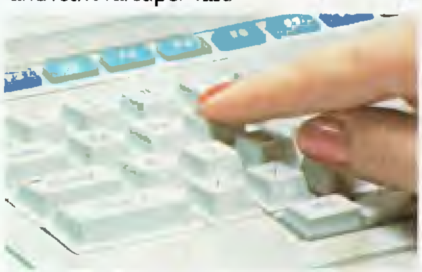
In addition there are facilities for full, on-screen editing, reverse video, partial scrolling and a full range of graphic symbols.

Character and Graphic Printer.

This fast, quiet printer will reproduce your graphic displays and, of course, print-out upper and lower case letters and symbols. A tractor/friction feed version is also available.

Data Storage/retrieval.

The MZ80B has a remarkable memory. 64K of RAM. And that constitutes all the memory area, giving flexible storage of any computer language and its software. The cassette deck is electromagnetically-controlled, with a data transfer speed of 1800 bits/sec combined with a unique programme search facility to make data storage and retrieval super-fast.



A typewriter-style keyboard incorporates characters and symbols plus a numeric key-pad and ten user-definable keys for fast and simple operation.

BASIC is, of course, provided with Z-80 Assembler Packages, PASCAL and a BASIC compiler.

Floppy Disk Drive.

A twin Floppy Disk Drive unit can be added which will give you 560 bytes of storage on double-sided, double-density disks.

Comprehensive Documentation.

Each MZ80B comes complete with a full set of documentation including an owners' manual giving full circuit diagrams, a monitor reference manual and programming manuals.

Interfaces

RS-232C and IEEE Interfaces are available from January 1982 allowing the MZ80B to communicate with scientific instruments and other peripherals.

CP/M*2.2

CP/M* is also available making a wide range of packages immediately available including wordprocessing, financial modelling, data base management to mention but a few. CP/M* also increases the disk capacity to 680K.

(CP/M* is a Trade Mark of Digital Research Ltd).

SHARP
First, and foremost

SHARP ELECTRONICS (UK) LTD., COMPUTER DIVISION, SHARP HOUSE, THORP RD., NEWTON HEATH, MANCHESTER M10 9BE. TELEPHONE: 061-205 2333.

Please send me full information on the Sharp MZ80B computer.

Name

Address

Tel:

To: Sharp Electronics (UK) Ltd., Computer Division, Sharp House, Thorp Road, Newton Heath, Manchester M10 9BE. Telephone 061-205 2333.

ECM 3/82